National Library of Canada
Bibliothèque nationale du Canada

Canadian Theses Service
Service des thèses canadiennes

Ottawa, Canada
K1A 0N4

NOTICE

The quality of this microform is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Previously copyrighted materials (journal articles, published tests, etc.) are not filmed.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

Les documents qui font déjà l'objet d'un droit d'auteur (articles de revue, tests publiés, etc.) ne sont pas microfilmés.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30.

NL-339 (r. 88/04)

Canada

THE UNIVERSITY OF ALBERTA

IS CANADIAN FARMLAND A GROWTH STOCK?
THE FINANCIAL RISKS AND RETURNS FROM INVESTING CAPITAL IN CANADIAN AND ALBERTA FARMLAND, 1970-1986.

BY

© CATHERINE A. MAIN FREEMAN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF SCIENCE

IN

AGRICULTURAL ECONOMICS

DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

SPRING, 1988

Permission has been granted to the National Library of Canada to microfilm this thesis and to lend or sell copies of the film.

The author (copyright owner) has reserved other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without his/her written permission.

L'autorisation a été accordée à la Bibliothèque nationale du Canada de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.

L'auteur (titulaire du droit d'auteur) se réserve les autres droits de publication; ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation écrite.

ISBN 0-315-42797-3

THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR: CATHERINE A. MAIN FREEMAN

TITLE OF THESIS: IS CANADIAN FARMLAND A GROWTH STOCK?
THE FINANCIAL RISKS AND RETURNS FROM INVESTING CAPITAL
IN CANADIAN AND ALBERTA FARMLAND, 1970-1986.

DEGREE: MASTER OF SCIENCE

YEAR THIS DEGREE GRANTED: 1988

Permission is hereby granted to THE UNIVERSITY OF ALBERTA LIBRARY to reproduce single copies of this thesis and to lend or sell such copies for private, scholarly or scientific research purposes only.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

Catherine Main Freeman
(Student's signature)

4605 Windsor Lane
Bethesda, Maryland, 20814

Date: March, 1988

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **Is Canadian Farmland a Growth Stock? The Financial Risks and Returns from Investing Capital in Canadian and Alberta Farmland, 1970-1986.**, submitted by Catherine A. Main Freeman in partial fulfilment of the requirement for the degree of Master of Science in Agricultural Ecomnomics.

Michele Veeman

Supervisor

Leonard Bauer

Date: 10 April 1988.

ABSTRACT

During the period 1970 to 1986 Canadian and Alberta farmland can be characterized as a growth stock. Values of farm real estate have been rising more rapidly than the rate of inflation, displaying a form best described by a cubic polynomial function. Growth in farm real estate values has therefore not been constant, but has averaged 4.7%, representing an overall increase in real estate values of nearly 150% during the period.

As farm real estate prices have changed returns to capital invested in Canadian and Alberta farm real estate have been variable. While annual income from rent has remained a constant 0.7% of real estate values, returns in the form of capital gains in farm real estate values have ranged from a high of 19.5% in 1974 to a low of -11.3% in 1983 and were positive for only 9 out of the 17 years in the study. Despite this variability, real returns to equity capital invested in farmland averaged 4.0% from 1970 to 1986.

The variability in both farm real estate prices and returns during the period 1970 to 1986 left those who had capital invested in farm real estate facing several different types of risk. Unpredictable prices posed a risk to holding farm real estate as a single asset investment portfolio. It was found that diversification of a single asset portfolio somewhat reduced price risk. Uncertainty in the magnitude of returns had an impact of the financial position of the business. During 7 out of the 17 years in the study, business growth in Canada and Alberta was negative, even though in total, the aggregate farmer in Canada had a minimum of $5.99 worth of assets (and $5.00 in equity) covering every dollar of debt and farm assets were 85.5% equity owned.

ACKNOWLEDGEMENT

Every project, especially one as demanding as preparation of a thesis, owes its final form to the input of many people. This thesis has benefited from the ideas and encouragement of friends and family members scattered from Alberta to New York and Washington, D.C.

In the project's initial stages, Mona Cox and Norm Thompson of the Planning Secretariat of Alberta Agriculture extended their wise counsel and optomistic perspectives in addition to their unquestioning support and encouragement. I am grateful for the financial funding provided by Alberta Agriculture under the auspices of the Planning Secretariat.

During the research phase, Dr. Travis Manning and Dr. Linda Chase Wilde, both of the Department of Rural Economy, University of Alberta shared data and background materials which they had collected.* When data related questions arose, staff of the Edmonton and Ottawa offices of both Statistics Canada and Farm Credit Corporation were attentive, courteous and very helpful in fielding questions, and providing data whether unpublished or newly published. Mr. David Freshwater, serving the U.S. Senate, graciously provided me with the pieces of data which completed my research; a hard to come by copy of Statistics Canada Catalogue Number 21-603E.

The first typed draft was cheerfully deciphered from pages full of scribbles and corrections by James Freeman. He also read and reread the initial drafts, helping edit, providing counsel and encouragement. He then dedicated long hours as my draftsman and helper despite the demands of his own hectic schedule. I cannot express how grateful I am for his help, his

friendship and his love.

The technicalities of polishing the final drafts were facilitated by Dr. Stavros Papadopulos of S.S. Papadopulos and Associates, Inc. who most graciously and generously extended to me the use of his firm's resources. I am grateful for the use of the S.S. Papadopulos and Associates, Inc. offices, photocopiers, high quality printers, plotters, computers.

Dr. M.M. Veeman, my advisor from the Department of Rural Economy, University of Alberta initiated the project with her ideas. She then graciously accomodated a long distance student/ advisor relationship. In the final stages of the project, her careful editing of the manuscript added polish to the final product. Before this manuscript is completely finished, it will have the touches of two other people, the members of my defence committee, Dr. Len Bauer, Department of Rural Economy and Dr. Glen Mumey, Dean of the Department of Business Administration, University of Alberta.

Last but not least, there was one old dog who sat with me through every hour during every stage of this project. I am grateful to Woody for his faithful companionship.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
1.	INTRODUCTION	1
2.	BACKGROUND	3
	2.1 A Market for Farmland	3
	2.2 Supply and Demand for Farmland	4
	2.3 The Investment Decision	8
	2.4 The CAPM Net Present Value Approach to Land Valuation	9
	2.5 Discount Rates	11
	2.5.1 Real Rates of Return	11
	2.5.2 Actual Rates of Return: The Simple Discount Rate	11
	2.5.3 A Complex Discount Rate for Equity Financing	12
	2.5.4 A Complex Discount Rate for Debt Financing	14
	2.6 Earnings from Land Ownership	15
	2.6.1 Rent	16
	2.6.2 Rent and Capital Gains	18
	2.6.3 Inflation	21
	2.7 Capital Gains	21
	2.7.1 Capital Gains in a No-Growth Model	21
	2.7.2 Capital Gains in NPV Growth Models	24
	2.7.3 Capital Gains in the Farm Accounting System	27
	2.8 Growth Stocks	30

2.8.1 Growth Stocks: Financial Market Growth Stock vs. Land Growth Stocks 30

2.8.2 Melichar's 1979 Study 32

3. METHODOLOGY 34

3.1 The Model 34

3.1.1 Growth: Changes in Land Values 34

3.1.2 Growth: Changes in Net Worth 34

3.1.3 Growth: Real Capital Gains 38

3.1.3.1 The Consumer Price Index 38

3.1.3.2 Two Methods of Calculating Real Capital Gains 39

3.2 The Data 41

3.2.1 Secondary Data 41

3.2.2 Time Series Data 43

3.2.3 Financial Data 43

3.2.4 Aggregate Data 45

3.3 Limitations 46

3.3.1 Observational Error 46

3.3.2 Specification Error 47

3.3.3 Conceptual Error 47

4. RESULTS AND DISCUSSION 48

4.1 Is Canadian or Alberta Farmland a Growth Stock? 48

4.1.1 Real Estate Values, 1926 to 1986 48

4.1.2 Growth in Real Estate and Other Farm Assets 50

4.1.3 The Best Fitting Functional Form 52

4.2 Annual Growth Measures 56

4.2.1 Farm Real Estate 60

4.2.1.1 Nominal and Real Growth 60

4.2.1.2 Growth in Real Estate in Canada and Alberta 61

4.2.2 Farm Assets 63

4.2.2.1 Methods of Calculating Growth in Farm Assets 63

4.2.2.2 Using Farm Assets as a Proxy for Farm Real Estate 65

4.2.3 Growth in Farm Business Equity 66

4.3 Returns to Owning Farm Real Estate 69

4.3.1 Annual Returns to Farm Real Estate 69

4.3.2 Annual Returns to Farm Assets 72

4.3.3 Capital Gains as a Return to Real Estate 74

4.3.4 Capital Gains as a Return to Farm Assets 76

4.3.5 Total Imputed Economic Return to Real Estate 77

5. VARIABILITY ANALYSIS AND DISCUSSION 80

5.1 Price (Market Risk) 82

5.1.1 Single Asset Risk: Risk Related to Variations in Return 83

5.1.2 Risk Related to Price of Farm Real Estate 85

5.1.3 Real Estate in the Farm Portfolio 86

5.2 Business Risk 88

5.2.1 Solvency 91

5.2.1.1 Owning a Growth Stock: The Impact on Solvency 93

5.2.2 Financial Efficiency 94

5.2.2.1 Owning a Growth Stock: The Impact on Financial Efficiency 96

5.2.3 Profitability 96

5.2.3.1 Owning a Growth Stock: Business Profitability 101

5.3 Financial Risk 101

5.3.1 Cash Flow Issues 102

6. CONCLUSIONS 107

REFERENCES 111

APPENDIX 1. WORKSHEET TABLES AND WORKING VARIABLES 117

APPENDIX 1.1 CANADIAN AGGREGATE DATA 118

APPENDIX 1.2 ALBERTA AGGREGATE DATA 126

APPENDIX 1.3 WORKING VARIABLES AND ASSUMPTIONS 134

APPENDIX 2. AGGREGATE CANADIAN FARM REAL ESTATE VALUES, 1970-1986 151

APPENDIX 3. CANADIAN INDEXED VALUES FOR FARM ASSETS AND INCOMES 153

APPENDIX 4. POLYNOMIAL REGRESSIONS DETAILED 155

APPENDIX 4.1 POLYNOMIAL REGRESSIONS 156

APPENDIX 4.2 CALCULATION OF FUNCTIONAL FORMS 158

APPENDIX 4.3 HISTORIC FARM REAL ESTATE VALUES DESCRIBED BY A CUBIC MODEL 159

APPENDIX 5. THE CALCULATION OF STATISTICAL MEASURES OF RISK 163

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
4.1	Measures of growth in the farm sector between 1970 and 1986.	57-58
4.2	Rates of return to farm assets and farm real estate in Canada and Alberta, 1970 to 1986.	70-71
5.1	Risk analysis of owning farm real estate.	84
5.2	Financial ratios for the hypothetical aggregate Canadian and Alberta farm reported over the period 1970 to 1986.	89-90
5.3	Price to earnings (P/E) ratios for aggregate Canadian and Alberta values from 1970 to 1986.	103

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
2.1	Theoretical supply and demand curves for aggregate farmland.	6
4.1	Farm real estate values, 1926-1986.	49
4.2	The value of farm land, farm real estate and total farm assets, 1970-1986.	51
4.3	Polynomial regressions of Canadian farm real estate values.	54
4.4	Growth rates in real dollar values of Canadian farm real estate, equity in farm assets, and total farm assets, 1970-1986.	59
4.5	Real and nominal dollar rates of growth in Canadian farm assets.	62
4.6	The CMF and Melichar methods of calculating growth rates in in Canadian farm asset values.	64
4.7	Current returns to farm real estate and farm assets, indexed to 1981.	73
4.8	Real capital gains returns in values of Canadian farm real estate and farm assets, 1970-1986.	75
5.1	A comparison of real aggregate returns to Canadian farm sector investment, 1970-1986.	81
5.2	Profitability in the Canadian farm real estate market, 1970-1986.	97
5.3	Rates of return on equity capital investment, 1970-1986.	99

1. INTRODUCTION

Canadian farmland is not sold on a stock exchange, nor does it appear on stock lists, but investment in farmland for the past forty years has been considered to be an excellent hedge against inflation and as an opportunity to realize positive capital gains. The potential of a profitable farm investment must seem enticing to an investor who comes across a magazine advertisement similar to one that appeared in the June, 1987 issue of **Cattleman**. In the advertisement, large tracts of deeded land were offered for sale. The land sale was purported to "present an excellent agricultural investment opportunity -- (due to) today's lower land values..." (p. 29). It could be questioned whether the concerns of a farmland investor may differ from or be similar to those of other investors. Investors in both farmland and more traditional types of investments expect that they will benefit in some designated way. In both cases the anticipated benefits must outweigh the economic and noneconomic costs of the investment.

In 1979, Emanuel Melichar of the Federal Reserve Board classified U.S. farmland as a growth stock. By doing so he implied that investment in farmland was similar to buying shares of, say, Xerox or IBM which are viewed as growth stocks. In a growth stock, capital appreciation is an appreciable component of the returns derived from owning these assets. This thesis is concerned whether the characterization of farmland as a growth stock also applies in Canada and in Alberta. Furthermore, if farmland can thus be characterized as a growth stock, how does this effect an investor's perception of his financial position before and after the transaction? How does this affect the farmer, who is primarily a businessman, trying to make a profit from his assets?

This study will attempt to answer these questions by identifying, describing and measuring the changes over time in returns form farming activities and from ownership of Canadian and Alberta farmland. Melichar's model of growth accounting is applied and returns to real estate and farm assets are calculated for the years from 1970 to 1986. In addition, the repercussions of holding a large proportion of a family's wealth in a growth stock such as farmland are discussed in terms of impacts on the farm business.

With these objectives as a guide, Chapter 2 of this study contains an outline of the theoretical background to land valuation issues and discusses literature from this area. Then the methodology used for quantifying and qualifying growth is discussed in Chapter 3. In Chapter 4, the results of the spreadsheet analysis are presented. Finally, these data are used to analyze the impacts of changing asset values on farm level risk in Canada. The results are given in Chapter 5. It is concluded that the behavior of a growth stock such as Canadian farm land has profound impact on the characteristics of an investor's portfolio. In the case of the farmer, these impacts affect his business, his income and his family wealth.

2. BACKGROUND

The purchase or holding of farmland is an investment decision. Whether buying or holding land, the purchaser is willing to forego investing in an alternative capital investment in return for the benefits that he expects will accrue from the ownership of land. The seller may be willing to liquidate his capital held in the form of farmland if other forms of investment or monetary use have become more attractive or if it is felt that he can earn a fair salvage value. How much to pay for land and how much to sell land for are decided by the investors, whether buyer or seller, on the basis of certain macroeconomic and microeconomic criteria.

2.1 A MARKET FOR FARMLAND

The price of land is established in a free marketplace. In a perfectly functioning land market, pricing will be efficient if there are a large number of buyers and sellers, any one of whom does not influence the entire market; if there is perfect freedom of entry and exit; if the parcels are homogeneous so that prices differentiate only on the basis of quality and location; and if there is perfect knowledge in the marketplace.

However, there are conditions peculiar to land which impede efficient market functioning. Parcels of land are heterogeneous, differing in location and quality. Parcels sold in any one period, for example in a year, represent only a small proportion of land held. In addition, land is immobile and unstandardized. Where farmland is traded in relatively unorganized low-volume local markets or in cases where the transactions themselves take years to complete, market information is not perfect (Robison et al. 1985).

Despite these inefficiencies in the farmland marketplace, there is competition for capital from both within and without the agricultural section. Within the sector, farmers who currently earn large enough returns to hold their capital in farming establish prices. Outside the sector, returns from alternate uses of capital establish a benchmark for returns to capital invested in farm real estate. The investor, in deciding the most profitable investment choice, will take such considerations into account. Factors such as high general inflation or a weak dollar which influence the performance of the entire economy also affect an investor's time value of money, perception of risk and the price he is willing to pay (Tweeten, 1980; Aplin et al. 1977; Castle and Hoch 1982).

2.2 SUPPLY AND DEMAND FOR FARMLAND

The price of a resource such as land is a function of supply and demand. The price will vary from region to region due to physical differences. Soil type, climate and management practices effect fertility, subsequent crop types and crop yields. Upward or downward shifts in productivity due to capital improvements such as irrigation, drainage or capital attrition through leaching, erosion or salinization will have a direct impact on the price an investor is willing to pay (Tweeten, 1966).

The price of land is generally affected more by demand factors than by supply side factors. Land is a resource that in aggregate is limited in quantity. There is some disagreement regarding the degree of scarcity. Some researchers feel that the aggregate quantity of land is fixed because new land cannot be developed despite strong demand (e.g. Reinsel and Reinsel, 1979; Burt, 1986). They feel that the aggregate supply of land is unresponsive to changes in price and thus completely inelastic as depicted in Figure 2.1 by the vertical supply line S_1. Others, like Hughes et al. 1984, maintain that "the total supply of land is not fixed. Price increases for land can lead to land improvements, while price declines can lead to removal of farmland for other uses. It can be expected therefore that the supply of farmland in the U.S. has a small positive slope" (p.757). In Figure 2.1, S_2 is depicted with a small positive slope and available quantity (q_1 to q_2 in Figure 2.1) increases slightly with increased price (p_1 to p_2).

Taking either perspective, a classic supply function for land does not exist. At best, it can be described as very inelastic - at worst, totally inelastic. Therefore demand for land will be the major factor in determining the price (Burt,1986).

Reinsel and Reinsel (1979) give a list of macroeconomic factors which would give rise to increased demand for land. In brief these are:

1) Population growth increases the demand for space.

2) Inflation.
   a) Buyers see land as a hedge against rising prices.
   b) The returns to land may inflate more than the returns to other types of capital.

3) Changing access to financing and varying credit terms.
   a) Lower interest rates from concessional credit.
   b) Longer repayment periods.

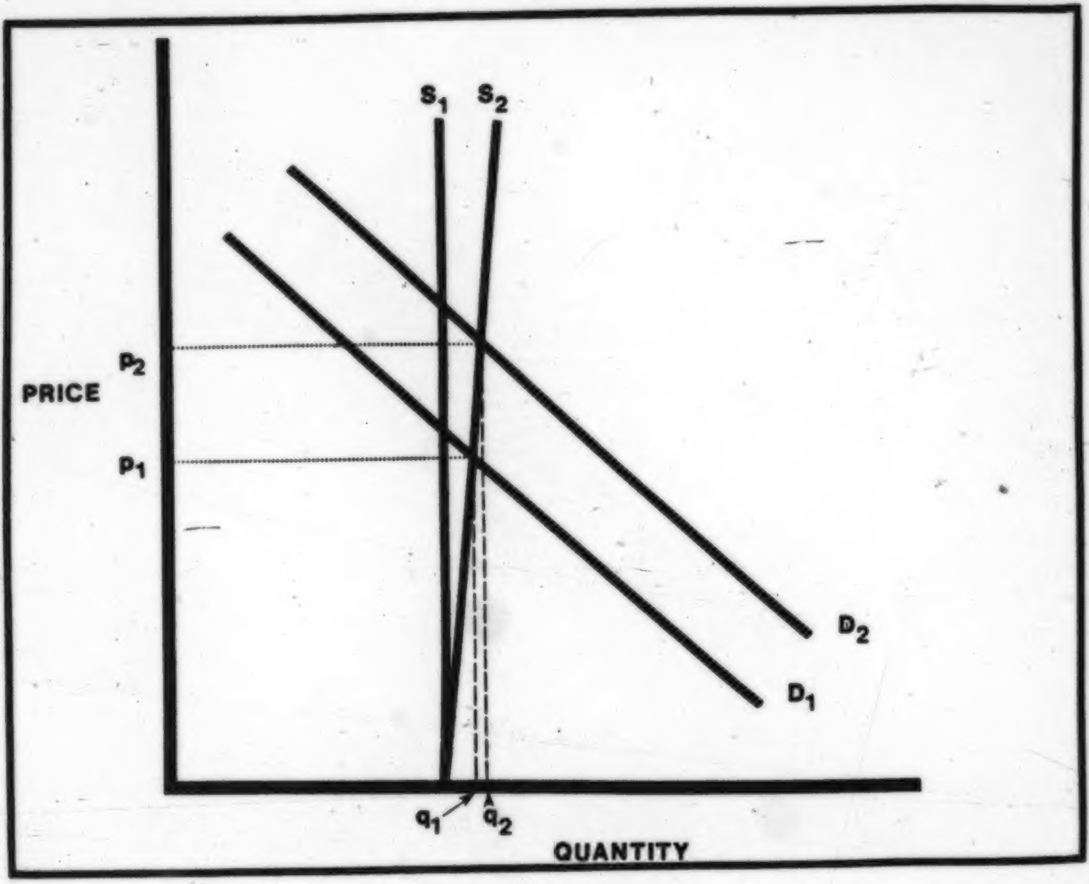


Figure 2.1 Theoretical supply and demand curves for aggregate farmland. While a classic supply curve for aggregate farmland does not exist, two descriptions of the aggregate relationship for supply of farm land are proposed. One views the curve as completely inelastic (S_1), the other sees the supply of farm land as very inelastic (S_2). Assuming an inelastic supply curve, the aggregate quantity of farmland supplied will respond only a very little (q_1-q_2) to increases in price (p_1-p_2). Price increases may be caused by a shifting of the demand curve for aggregate farm land (D_1-D_2).

    c) Lower required down payments.
    d) Government guarantees for marginal borrowers.

4) Taxation policies which favor different types of assets.
    a) Production receipts.
    b) Capital gains or land appreciation.
    c) Real estate inheritance and estate taxes.

5) Increased demand for agricultural exports.

6) Preferential use or assessment of land.

7) Stabilization of farm incomes.
    a) Increasing value of farm production.
    b) Reducing risk of farm earnings.

As depicted in Figure 2.1, any of the factors listed above would shift demand for land to the right, from D_1 to D_2. Since farmers and nonfarmers "have different sources of income, use land in different ways, and might have different portfolio balancing preferences, their demands for land can shift over time in divergent ways" (Hughes et al. 1984, p.755). Their demand for land will be more elastic and responsive to changes in price if they can either find attractive substitutes for land (e.g. a technology which enables output to be produced at a lower cost per unit (Doll and Orazem, 1978)) or if a large percentage of their income is spent on land.

The different demands for land imposed by investors may be broken into three main types: productive, consumptive and speculative. Productive demand refers to the pressure exerted by economies of scale toward larger parcels of land as a means of achieving productive efficiency. Consumptive demand provides noneconomic benefits to the investor. Investor motivation to own land may be for: 1) a country residence or retreat; 2) an area for private recreation; 3) obtaining or maintaining a preferred lifestyle or 4) keeping land in a family (Pope and Goodwin, 1984; Pope, 1985). Speculative demand is generated by individuals who consider investment in land as a hedge against the effects of inflation or for beneficial taxation policies (Shalit and Schmitz, 1982). Despite the problems of quantification of a myriad of economic and noneconomic factors, the marketplace brings all those motives to a common denominator -- the sum which each investor is willing to pay for these factors.

2.3 THE INVESTMENT DECISION

According to the assumptions of simple microeconomic theory, the goal of the firm is to maximize profits. However, this is not always the case for an investor in farmland. Aplin et al. (1977) state that "maximizing profit is not always synomynous with maximization of owner's wealth. Wealth maximization is a more inclusive goal than profit maximization. It takes into account earnings per dollar invested by owners and risk associated with these earnings as well as other factors which affect the value of the firm" (p.3).

Capital investment involves the estimation of future trends. These depend on the investor's individual attitudes to the risks and opportunities in investment (profitability), his financial position (feasibility) and his position in his life and business cycle. From investor to investor, expectations of the future will be heterogeneous because experiences and interpretations of the past differ. One consequence of this heterogeneity was identified by Brown and Brown (1984) who argue that it may be the extreme investor who establishes the price of land: the financially secure, the optimist or the risk taker; not the average investor with average expectations.

2.4 THE CAPM NET PRESENT VALUE APPROACH TO LAND VALUATION

A technique that is commonly used to estimate returns and to compare the profitability of alternative investments is the capital asset pricing model (CAPM). A simple CAPM model often utilized by land appraisers and land value researchers for its clarity of interpretation is the capitalization formula. It is represented by the mathematical relationship:

$$V = I/r \qquad \text{(Eq. 2.1)}$$

where V is the current value of land, I is the annualized earning generated by the land and r is the chosen discount rate. Conceptually, Equation 2.1 describes land values (V) as a function of the relationship between earnings generated by assets (I) and the opportunity cost of capital (r). If expected earnings rise, so will land values. If expected earnings decline, land values will decrease.

The assumptions underlying Equation 2.1 are that land is a durable and non-depreciating asset with a productive life that is infinite in length. Consequently, the stream of services which land provides continues into perpetuity. Long run expectations for returns and the cost of capital are assumed to be constant. The planning horizon is therefore assumed to be infinite. However, Barry et al. (1979) state that the capitalization formula has limited applicability over a time period of twenty years or less.

The net present value criterion of the CAPM is commonly applied to a future stream of cash flows in order to translate them into a current value. Examples of applications of this technique are found in case studies by

Barry (1980), Bauer (1983), Carter (1981), Castle and Hoch (1982), Dobbins et al. (1981), Melichar (1979), Reinsel and Reinsel (1979), Tweeten (1980) and White and Musser (1982).

Although the CAPM is widely used to estimate land values, there are reasons to caution against the unquestioning application of the model and its valuing technique. These are listed by Barry (1980) as follows:

> 1)Markets are assumed to be highly efficient so that expected returns quickly and fully reflect available information.
>
> 2)Transfer costs, tax obligations and indivisibilities are assumed not to exist.
>
> 3)Lending and borrowing rates are considered equal for risk-free financial assets.
>
> 4)Investors are assumed to be risk-averse, well-diversified and to hold homogeneous expectations that are fully characterized by means and variances over single period horizons.

Critics of CAPM voice concern regarding the application of the model to land values since:

> 1)The land market is inefficient because of the local, low-volume and immobile nature of land (Carter, 1981; Kost, 1968). In addition, the operators of inefficient units are often unaware of better, alternative uses of their resources and thus buy land.
>
> 2)Land does not fit into a well-diversified portfolio because it is illiquid and indivisible (Carter, 1981).
>
> 3)Land investors do not hold homogeneous expectations (Carter, 1981; Brown and Brown, 1984).

While there is little doubt that there are valid concerns about the applicability of the CAPM, it is important to assess whether or not the explanatory capacity of the CAPM is diminished by modifying or relaxing some of the basic assumptions. Few disagree that the CAPM forms an appropriate starting point for estimating the value of assets such as farm real estate. However, there is less unanimity in the specification of how the expectations of future net cash flows are formed and the appropriate discount factor to use.

Subsequent sections will discuss the specification of the discount rate and the earnings stream under less rigorous assumptions and facilitate a more realistic and flexible application of the relationships represented by the capitalization formula.

2.5 DISCOUNT RATES

2.5.1 Simple Rates of Return

By rearranging the capitalization formula (Eq. 2.1) to:

$$r = I/V \qquad \text{(Eq. 2.2)}$$

the ratio of asset earnings to investment price is determined. As a simple rate of return, it is a variable sensitive to the magnitude and variations in earnings (I) and to changes in farmland prices (V). This simple rate is realized if there is no consideration of any outside factors.

2.5.2 Actual Realized Rates of Return: The Discount Rate

Tweeten (1981) cautions that the actual rate of return, which he defines as the rate which compensates savers for postponing consumption in the absence of price changes, may differ from the simple rate of return due to risk or to both tangible and intangible benefits of holding farmland. The actual rate of return is also referred to as the discount rate which reflects the cost of capital or opportunity cost of funds committed to the purchase of farmland (Boehlje and Eidman 1984).

2.5.3 A Complex Discount Rate for Equity Financing

If a sophisticated investor adjusts his discount rate to better reflect his environment, the adjustment might be based on the riskiness of land investment when compared to alternative investments, differences in expected rates of growth in earnings and differences in the noneconomic benefits associated with alternative investments (Boehlje and Eidman, 1984). The component parts of the more complex discount rate are specific to each investor. The choice of a discount rate must adequately reflect the fact that returns received early are of more value to the investor than returns received late because he can reinvest early earnings at the cost of capital. Brown and Brown (1984) define an investor's perception of uncertainty as the differing probability estimates that decision makers have for future events.

When the simple rate of return is altered by including factors such as risk, earnings, growth, noneconomic benefits or taxes in addition to inflation the actual realized rate of return is no longer equal to the simple rate. For any time period t, the compound discount rate might be:

$$r = (1+rm)^t(1+rr)^t(1+ri)^t(1-rg)^t(1-rn)^t(1-rx)^t - 1 \qquad \text{(Eq. 2.3)}$$

If this rate remains constant into perpetuity, the model becomes:

$$r = (rm + rr + ri - rg - rn - rx) \qquad \text{(Eq. 2.4)}$$

where all rates are annual and:

r = the actual realized (effective) aggregate discount rate;

rm = the simple discount rate, cost of capital or real monetary interest rate;

rr = the risk premium for investment in land;

ri = the expected real inflation rate;

rg = the expected growth rate in earnings;

rn = the rate of noneconomic returns to ownership;

rx = the marginal tax rate; and

t = time, in years.

The relationships developed in Equation 2.4 imply that an investor is willing to accept an actual realized return to farmland that is less than the simple market rate (rm) if he is receiving or expects to receive growth in earnings from farmland (in income or in capital gains), if he values noneconomic benefits from land ownership (Kost, 1968) or if he has a low marginal tax rate. If, on the other hand, the investor faces rates of inflation or risk he will demand a realized rate of return which is higher than the simple discount rate (Doll and Widdows, 1981).

While making no stipulation as to magnitudes, one can appreciate the direction of the influence that each of the variables will have on farm land values if Equation 2.4 is incorporated into the simple capitalization formula (Eq. 2.1). The present value of land will increase if the aggregate discount rate decreases. This will occur if:

1)The expected growth rate of earnings rises relative to inflation or alternative investment earnings.

2)The rate of return for noneconomic benefits of land ownership rises.

3)The marginal tax rate, which favors capital gains income above taxable cash income, increases.

4)Income taxes, property taxes or capital gains taxes decrease.

5)The real monetary interest rate, the general inflation rate, or the risk premium for land investment falls. When tax or inflation factors are included, both cash flow earnings and discount rates must be adjusted (White and Musser, 1982; Robison et al, 1985).

Any of these exogenous influences on the returns to land might be incorporated into an individual's discount rate for long-run or short-run investment analysis. In practice, Burt (1986) argues that market participants will simply use an estimated long-run equilibrium real rate of interest as the discount rate in the capitalization formula. His justification is that investment in land is a long term investment entailing large transaction costs and thus all influences and considerations besides long-run real interest rates are inconsequential (p.12).

2.5.4 A Complex Discount Rate for Debt Financing.

In addition to the rate adjustments which are necessary for equity purchasers to evaluate Equation 2.4, several adjustments to the discount rate are used when debt capital finances the farm land purchase. Models presented by workers such as Dobbins et al. (1981) and Tweeten (1981) include adjustments for the required rate of return on equity (rm in Equation 2.4), the interest rate on borrowed funds and the proportion of the purchase financed by debt and equity. Tweeten (1981) focuses on the difference between the simple discount rate as a measure of the rate of return on farmland (rm) and the cost of inflation adjusted debt capital. Tweeten terms this difference mew. The actual discount rate (r) can be adjusted to reflect the use of debt capital by:

$$r = [rm - (ri\mu L)/rm] \qquad \text{(Eq. 2.5)}$$

where L is the ratio of debt to equity and the other terms are as previously defined for Equation 2.4.

The implications of a debt financing term such as the one defined in Equation 2.5 are twofold. First an investor is willing to accept a lower actual return on farmland (r) if he has underpriced or positively leveraged debt financing (Tweeten,1981). Secondly, as the ratio of debt to equity rises, the effective aggregate discount rate (r) falls causing land values to rise. This trend is exaggerated if the real monetary interest rate (rm) representing the rate of return on farmland exceeds the cost of debt capital. On the other hand, if the cost of debt capital exceeds the return from farmland, land prices will decline. The economic well-being of an investor will be enhanced by the purchase of an asset which promises a rate of return in excess of the estimated cost of capital (Alpin et al. 1977).

Concessional credit rates tend to increase mew and therefore exert upward pressure on land values. Tweeten (1981) suggests, however, that much of the impact of existing concessional credit has been realized and this will consequently have less impact in the future. Concessional credit that has been made available to farmers for the purchase of farmland gives farmers an advantage when bidding for land because these programs enable them to bid a higher price for farmland than nonfarmers.

2.6 EARNINGS FROM LAND OWNERSHIP

Returns to land investment come in several forms. An investor who owns land will receive annual returns in the form of rental payments; for holding land he may gain unrealized returns in the form of capital gains; from operating land he will receive a portion of his net farm income as a return to the land's productivity.

Earnings have a direct impact on land values. From the simple capitalization formula (Eq. 2.1) it can be seen that as returns to land rise, land values will increase; if earnings decrease, land values will fall. The present value of land is a function of the stream of anticipated earnings. There are, however, two schools of thought concerning the behavior of these earnings. One school contends that land values are a function of rental returns alone (e.g. Dobbins et al., 1981); the other school believes that land values are a function of a stream of steadily growing earnings and result in both increased rent and capital gains or losses from appreciating or depreciating land values (e.g. Castle and Hoch, 1982).

2.6.1 Rent

The rental of farm real estate pays the landowner for the services of land and buildings used for farm production. Rent is commonly determined in one of two ways: crop share or cash rent. Crop share rent involves an agreement between landlord and operator under which, for example, the landlord would receive 1/3 of gross crop returns and in return would assist the tenant in a 1/3 split of some agreed variable costs (fertilizer and weed control) and payment of all real estate taxes. The tenant would receive use of the land and buildings, receive 2/3 of gross crop returns, pay 2/3 of the designated variable costs and pay 3/3 of any other costs incurred (Bauer, 1983; Burt, 1986). This arrangement spreads the production and price risks between the landlord and tenant. In return for taking a portion of the risk, the landlord has a chance of a better return than under a cash rental agreement.

Cash rent involves a pre-arranged cash payment based on a specific price per unit (per acre or per animal unit). While cash rents are less common than crop share arrangements, they are widely used in areas where pasture is rented for grazing livestock. The advantage of cash rents is that there is a clear cash outlay for rent and therefore knowledge of rental values is more precise than are the estimates for crop share rents. Cash rents tend to be lower than crop share rents to compensate cash rent tenants for facing production and price risks alone. Cash rents therefore tend to underestimate overall returns to farmland (Tweeten, 1981).

Many factors influence rental values; the common feature however is that these factors all have an impact on farm level profits. On either a crop or cash basis, rental values are parcel specific (Vantreese et al. 1986) and therefore potential for profit is as heterogeneous as the natural resources of farm land -- soil fertility, mineral resources, climate and location. Rental values will change in response to profits generated by technologies which increase the efficiency of input combinations or decrease per unit cost of outputs (Doll and Orazem, 1978). They will also reflect any changes in farm/product prices due to increases in foreign exports or domestic demand for agricultural products (Tweeten, 1980).

From the analysis of land values and cash rental values between 1961 and 1978 in ten midwestern U.S. states, Tweeten (1981) concluded that "farmland earnings have kept pace with sharply rising land prices in recent years. Based on reasonable expectations of future land earnings, current land prices are justified by prospective future earnings from land used for farming alone. It is not necessary to introduce explanations such as speculation, urban encroachment or tax hedges to justify the current value of farmland" (p. 20). Using cash rents for leased farmland from eight of the same ten midwestern U.S. states in the period from 1963 to 1983, Alston (1986) drew conclusions that are similar to Tweeten's. In an investigation of rents and land values from 1960 to 1977 in Tippecanoe County, Illinois, Dobbins et al. (1981) found empirical evidence that variation in cash rents explained 94% of the variation in land values. Burt (1986) came to similar conclusions looking at crop share rents and land values from a select homogenous group of Illinois farmers using data from 1961 to 1981.

Using more general aggregate U.S. farmland data from 1910 to 1985 and a more dynamic capitalization model, Featherstone and Baker (1987) suggest that the price of land (farm assets) adjusts until the rate of returns to land is equated with the opportunity cost of investing in land along a time path of adjustments which consists of a series of shocks and reactions. They describe a dynamic "price bubble" adjustment in real asset values, real returns to assets and the real interest rate during the period from 1973 to 1984. They conclude that this bubble was largely driven by a shock to returns in 1973 and that real interest rates had only a very small influence on returns during the period.

2.6.2 Rent and Capital Gains

If rental values were increasing and in addition if they were perceived to be steadily growing, they could be incorporated into the simple capitalization formula (Eq. 2.1) as:

$$V = [(1 + I_g)/(r_m - r_g)] * Ir \qquad \text{(Eq. 2.6)}$$

where:

V = land values.

I_r = annual return (rent).

I_g = capital gains due to a growth in current earnings.

r_m = discount rate; real money interest rate.

r_g = expected growth rate in earnings.

If growth in rental earnings was expected to be constant and perpetual, this factor would be expressed by the capitalization model of Equation 2.7. Growth in earnings based on different assumptions than these are discussed in subsequent sections.

Introducing growth as both a growth in earnings (I_g) and a corresponding growth rate in the discount rate (r_g) causes land values to become very sensitive to even small rates of growth. "Capital gains themselves result from capitalization of a growing rent stream" (Featherstone and Baker, 1987, p. 533).

Capital gain returns occur when there are market changes in the value of a land owner's property. Capital gains include only price changes due to capital appreciation; they do not include changes in price due to changes in land quality or inflation. A capital gain increase in land value will increase the purchasing power of the land holder's net worth so that he could increase his consumption without reducing his net worth (Huff and Cusack, 1972). It is a return, though unrealized, to the land owner for simply holding his land while the market changed.

While unrealized, annual capital gains are considered to have value for several reasons. Firstly, capital gains serve to reduce risk by decreasing the degree to which equity is leveraged. Secondly, the gains provide reserves of equity which increase financial flexibility and the potential for business expansion (Plaxico and Klethe, 1979). Thirdly, unrealized capital gains take the place of savings and retirement funds which would have to be set aside if equity were not increasing. This increased equity serves as potential collateral for additional borrowing (Brinkman, 1981). Although capital gains are not realized annually, consideration of them is necessary to properly evaluate rates of return on investment in farm capital (Boyne, 1964; Brinkman, 1981).

Negative capital gains have the opposite effect of positive gains. Capital losses erode equity. The business will experience the consequent rise in financial risk as borrowing power shrinks and equity becomes ever more highly leveraged. The loss of real wealth will shrink the value of savings stored in the form of farmland. When capital gains are negative, the purchasing power of the land holder's net worth will decrease. He would have to decrease his consumption (business uses of equity or family withdrawals) in order to maintain the same level of net worth.

The difference between rent and capital gains is that while rent is an annual income return or flow which the landowner can expect for the productive services of his property, capital gains are a stock return to a landowner for holding property as the market value changed.

While rent may not always represent a cash income (i.e. for the owner/operator, rent is not cash income), it is usually a positive return. Capital gains, however, represent a return which can be either positive or negative.

2.6.3 Inflation

If the economy was in a stationary competitive equilibrium where all prices for assets and commodities inflated at the same rate as the general inflation rate, land prices in real terms would in effect, remain constant. However, in a dynamic economy, one in which inflation is not neutral (White and Musser, 1982), land rents and land values which increase in excess of the general inflation rate will experience what is termed "real" value increases (Feldstein, 1982; Tweeten, 1981). Appreciation of asset values will result in an increase in the purchasing power of the land owner's net worth which can be viewed as an increase in real wealth. Real and nominal dollar values will be discussed further in Methodology 3.1.3 and used in deriving the results given in Chapter 4.

2.7 CAPITAL GAIN

2.7.1 Capital Gains in a No-Growth Model

Adaptations of the Net Present Value (NPV) models for land valuation by inclusion of a growth variable vary somewhat in their scope and limitations. In a non-growth model these capital gains would be considered as an unanticipated occurrence or windfall. In the NPV method of evaluating investments there are several ways of handling a one time capital gain and growth in net worth. The most general model and the one which requires the fewest assumptions is of the form:

$$V_0 = P_0 + R_1/(1+r) + R_2/(1+r)^2 + \ldots + R_n/(1+r)^n + P_1/(1+r)^n \qquad \text{(Eq. 2.7)}$$

where:

V_0 = the present value of the asset.

P_o = the present purchase price.

R_1 .. R_n = the net earnings per period n accruing from the ownership of the asset. Note that n does not necessarily denote a uniform time series.

P_1 = the salvage value to be earned after time period n.

r = the discount rate.

This model accommodates uneven earnings, different planning horizons and an expectation for either a capital gain or loss realized at the end of the planning period upon disposal of the asset -- a one time capital gain. The model is based on the premise that the value of net earnings today is worth more than it would be in the future due to investment potential.

Using similar assumptions, Plaxico and Klethe (1979) examine the capital gains return expected over the length of a finite planning period (n):

$$V_o = ((P_n - P_o)(1 - T_c)) \; / \; \{[1 + D(1 - T)](1 + Z)\}^n \qquad \text{(Eq. 2.8)}$$

where:

V_o = the present value of an asset.

P_o = the present purchase price.

R_n = the sale price of property at the end of the planning period.

T = the marginal tax rate.

T_c = the marginal tax rate on capital gains.

D = the discount rate.

Z = the general inflation rate.

The model of Plaxico and Klethe is limited, however, because it does not consider the income stream derived from land ownership in the form of net rent. When both sources of income are considered, a simple derivation using the general model offered by Brealey and Myers (1981) is helpful, for it demonstrates the components which influence an investor's perception of the present value of land. If land were to be held for one year its price would be a function of the rent and the capital gains which were realized:

$$P_0 = (DIV_1 + P_1) / (1 + r) \qquad \text{(Eq. 2.9)}$$

where:

P_0 = the present value of land

P_1 = the salvage value of the land at the end of one year.

DIV_1 = the dividend or rental income gained.

r = the discount rate.

If the land were kept for two years, the present value would be:

$$P_0 = DIV_1/(1 + r) + (DIV_2 + P_2)/(1 + r)^2 \qquad \text{(Eq. 2.10)}$$

If the land were held until year H, the present value becomes:

$$P_0 = DIV_1/(1 + r) + DIV_2/(1 + r)^2 + \ldots + (DIV_H + P_H)/(1 + r)^H \qquad \text{(Eq.2.11)}$$

As H approaches infinity, a reasonable assumption, since land could conceivably remain productive throughout time, the present value of its terminal value approaches zero. If an infinite planning horizon is assumed, the present value of land can be expressed as a perpetual stream of cash rents in the form:

$$P_0 = \text{SUM}\,(DIV_t / (1 + r)^t) \qquad \text{(Eq. 2.12)}$$

This formulation does not explicitly exclude capital gains. It has been derived from the assumption that the present value of land is a function of income from both rent and capital gains with the additional restriction that the planning horizon of the investor is infinite. Doll and Widdows (1981) rationalize this assumption as follows: "At the end of t periods the asset may be sold and the sale value discounted back to the present. But the sale value is determined by the earnings from time t + 1 into the future. Each time the asset is sold, earnings are again extended into the future, and hence, without limit" (p. 730).

If the further assumption that there will be equilibrium in the long run so that constant expectations of returns and discount rate will prevail is placed on the model, the Brealey and Myers model can be simplified to:

$$P_0 = DIV / r \qquad \text{(Eq. 2.13)}$$

This is essentially the capitalization formula of Equation 2.1. The capitalization formula therefore includes the concept of capital gains, but does so under very restrictive assumptions of an infinite planning horizon and long run equilibrium. In addition, Melichar (1979) notes that changes in variables DIV or r will result in a new equilibrium value of P_0. The amount of change in P_0 is a capital gain.

2.7.2 Capital Gains in NPV Growth Models

In contrast to the assumption of one time capital gains in non growth models, capital gains in growth models are expected to occur annually throughout the planning period, even during intervals of equilibrium.

A NPV model used by Plaxico and Klethe (1979) describes the present value of land in which unrealized capital gains are viewed as the only income stream. The form of this model is:

$$V_l = SUM[(P_i - P_{(i-1)})(A)]/(X)^i + [P_n - P_o(1-A) - (P_n - P_o)T_c]/(X)^n \qquad \text{(Eq. 2.14)}$$

where:

V_l = the present value of land.

P_i = the current price of land.

P_o = the current price of land.

P_n = the salvage value of land.

A = $(0 < A < 1)$ is the proportion of increase in equity per year due to the price increase.

X = the compound discount rate used in the model.

T_c = the marginal tax rate on capital gains.

The A variable and its interaction with annual capital gains represents an attempt by Plaxico and Klethe to isolate the annual increase in equity caused by land value increases within the time frame of a finite planning horizon. This annual unrealized equity gain is assumed to be available as a financial reserve or as an equity base for expansion. The model is limited in application because it neglects annual rental income.

Bhatia (1971) provides several alternative suggestions for methods of specifying annual capital gains. However, instead of using several different models and methods of capital gains specification, many researchers have elected to utilize the various NPV growth models.

Castle and Hoch (1982) use a model in which rent increases by a real amount each year. Their model is of the form:

$$V = (R + C)/(1 + I) + (R + 2C)/(1 + I)^2 + \dots + SUM(R + sC)/(1 + I)^s \qquad \text{(Eq. 2.15)}$$

where:

R = rent
C = annual real increase in rent
I = the discount rate.
s = year

Not only does this model use real annual rental increases but it condenses into the form:

$$V = (R + C)/I + (C^*I)/I \qquad \text{(Eq. 2.16)}$$

This form is significant because it implies that the present value of land is a function of (R + C)/I, the capitalized annual rental income and (C + I)/I, the capitalized value of capital gains due to increases in rent. An assumption that limits this model is that there is an infinite planning horizon and therefore the terminal salvage value approaches zero. In addition, it is assumed in the long run, equilibrium will prevail so there are constant expectations of rent, annual increase in rent and an appropriate discount rate.

The form more commonly used describes a constant growth trend in earnings as a rate instead of the real amount used by Castle and Hoch (1982). In a constant growth model there may be year to year deviations in actual returns, but as long as the expected returns grow at a constant rate over a time period that approaches infinity, the model is applicable (Brealey and Myers, 1981). The model is of the form:

$$P_0 = DIV_1 / (r - g) \qquad \text{(Eq. 2.17)}$$

Vandeveer (1985) also used this model and concluded that during the period from 1960 to 1982, the expected growth in earnings (g) became an increasingly important component of annual land value changes in Louisiana.

If the growth in returns is assumed to be constant and perpetual, the form of the NPV model becomes:

$$P_0 = DIV_1 * (1 + g)/(r - g) \qquad \text{(Eq. 2.18)}$$

Melichar (1979) uses this form of the growth model to explain growth in U.S. aggregate farmland values from 1950 to 1978.

If the form of the growth model is further constrained by the assumption that expectations are perpetually stable, that is, in the long run there is equilibrium, the form becomes:

$$Pet = (1 + g)/(r - g) * DIV(1 + g)^t \qquad \text{(Eq. 2.19)}$$

It is this form of the growth model that Melichar (1979) uses to conclude that "the substantial capital gains experienced over most of (the period 1956-1978) were on the whole no greater than those that would have been expected to occur at equilibrium " (p. 1090). Doll and Widdows (1981) suggest that the treatment of growth in returns in Equation 2.19 is too limiting because it does not allow the flexibility of assuming the investor may annually reformulate growth rates and earnings as does the equally useful Equation 2.18.

2.7.3 Capital Gains in the Farm Accounting System

Capital gains have traditionally been included along with net farm income in estimating returns to farming. However, farm accounting is not adapted for inclusion of annual unrealized capital gains. Asset values found in the balance sheet are usually listed at cost. Farm accounting systems are often unable to handle both economic and accounting measures of return. Instead, these systems are generally designed to deal with income from sales, rentals, outside income contributed to the farm, wages, contract earnings and similar entries. Farm accounting systems do not easily accommodate capital gains.

Within the farm accounting system, assets are defined on the basis of their lifetime. This lifetime is viewed at a snapshot in time. However, in economic systems, assets like land are defined by the value of a stream of returns. While these are concepts are unreconcilable, in practice the different valuations made from within the two systems may be confused if they are not clearly distinguished while examining such issues as changing land values.

Aukes (1985) clearly defines the difference between accounting income and economic returns by saying that accounting income is an actual entity (e.g. cash receipts), an *ex poste* measure based on market transactions and prices, whereas economic income is a predicted value or an *ex ante*, personal concept. Because the two measurements are of incompatible magnitudes, they are not additive and therefore cannot be used interchangeably. An investor who is determining the relative profitability of alternative investments based on the CAPM should only use an economic measure of income. Accounting income is the appropriate measure to use when establishing the financial feasibility and the ability of the investor to make cash payments once he has identified his most profitable investment alternative.

In practice, capital gains are often ignored in the accounting system. The financial statements are drawn up on the basis of the historic, undiscounted purchase values. New acquisitions, reflecting their respective current market prices, are introduced with the purchase of land and are then locked into the financial records at that value. This method is simple since there are no adjustments to be made in the accounts or in the financial statements. Its defenders point out that capital gains are a return which is not captured until the asset is traded and these therefore should not be included in annual accounting of the farm business. However, the procedure could mislead a farmer into thinking that his borrowing capacity is considerably less than if current market values were used to evaluate his assets. The advantage of this method is that the growth of his business is isolated from growth in the value of his assets.

An alternative method of accounting for capital gains in farm financial statements is by updating asset values at fixed time intervals to reflect market values. On the other hand, this method might lead a farmer to conclude that he can carry a higher and higher debt load as land prices rise, leaving him increasing vulnerable to fluctuations in the value of land. Another problem is that with this method alone the farmer cannot distinguish between asset growth and business growth so that he can determine his debt servicing ability. Debt servicing is linked to business growth but not to asset growth.

A third method attempts to overcome the problems associated with the previous two methods by simply combining them. From one set of farm accounts, two sets of financial statements are derived, one reflecting asset purchase value, the other a current market value. Using these two sets of information, a farmer can determine his business growth, thereby enabling him to assess both his debt servicing ability and his debt incurring capacity. However, this method may be time consuming because of the continual need to update current land value records. In addition it does not resolve the basic conflict between farm accounts which record the flow of income and assets which generate a stock return.

2.8 GROWTH STOCKS

Brealey and Myers (1981) define a growth stock as a stock purchased in expectation of capital gains. It is the future growth of earnings rather than the annual return which is of primary importance. In contrast, an income stock is purchased for its level of dividend or annual return. For example, on a farm level, Melichar (1979) has classified U.S. farmland as a growth stock while a herd of beef cattle would be seen as an income stock. Melichar (1979) concludes: " farm real estate is a 'growth stock' best and most easily owned by those who can tolerate its low annual return in the first few years after its purchase" (p. 1091).

2.8.1 Financial Market Growth Stock vs. Land Growth Stock

Whether capital is invested in a stock market growth stock or in land, it has similar characteristics: low rates of annual return and real wealth gains due to asset appreciation. However both the stocks and the investors are quite different. Stocks in the Standard and Poor 500 list of blue-chip stocks had price/earnings (P/E) ratios that ranged between 13 and 20 in the first 10 months of 1987. P/E ratios for stock market growth stocks were much higher at 38 for Microsoft and 55 for Homestake Mining. In contrast to these P/E ratios, the average farm real estate P/E from 1970 to 1986 has been 45 (calculated from Statistics Canada values for value of aggregate farm real estate divided by the value of aggregate rent. The resulting P/E quotients are listed in Table 5.3 and discussed in Chapter 5, section 5.3 titled Financial Risk.).

The investors in these two different growth stocks would typically be in different financial circumstances. The urban investor, using a broker to make the transaction, often pays for his purchase with cash or equity capital. The farmer, dealing directly with the seller, his banker and his lawyer would typically make the transaction using a large percentage of debt capital. Both stocks are sold through a bidding process.

The urban investor would often be buying a stock market stock as part of a diversified investment plan. He could own the growth stock, a small business, some inventories, a portion of mutual fund, some savings bonds, insurance, term deposits, and a house. Having his capital investments diversified and a relatively small proportion of his assets tied up in a growth stock would buffer him from financial risk if its value were to decline.

The farmer on the other hand, typically has two-thirds of his capital in his farmland growth stock. His capital is also invested in machinery, crop inventories, livestock, term deposits and insurance. While his capital may be invested in as many different types of assets as his urban counterpart, holding such a large proportion of his capital in one stock will have two effects. First, the farmer places himself in a position where he has potential for large capital gains if asset values rise. He also leaves himself vulnerable to substantial real wealth losses if asset values fall. Second, the greater the percentage of his capital which he holds in the form of a growth stock, the less capital he will have available for investment in income producing types of capital. A farmer's choice of portfolio mix therefore will predicate his returns.

2.8.2 Melichar's 1979 Study

Melichar's 1975 and 1979 studies were conducted with aggregate U.S. farm-level data for the period from 1950 to 1978. Melichar reconstructed an annual balance sheet. He adjusted this for inflation based on the arguments of Hoover (1962) and Boyne (1964) and for net investment based on Grove (1960) in order to derive an estimate of the magnitude of real capital gains accruing to farmers from price changes in their assets. Using the most restrictive forms of growth models detailed in Equations 2.19 and 2.20, Melichar compared his estimate of annual real capital gains to aggregate annual net farm income from which he had subtracted an imputed value for returns to operators' labor and management. From his work Melichar concluded that:

> 1)The origin of recent real capital gains could be traced to a rising annual return to assets.
>
> 2)"A farm economy characterized by rapid growth in the real annual return to assets (would) tend to experience large annual real capital gains and a low rate of return to assets" (1979, p. 1085).

Although the main focus of Melichar's 1979 work was to discuss the relationship between capital gains and current income, the idea that U.S. land is a growth stock is appealing because it lends a fresh perspective to many current farm issues. If, as Melichar (1979) suggests, land is a growth stock then many of the problems within the farm sector such as cash flow difficulties, rising debt, financial barriers to entry-level farmers, or the "attraction of farm estate for persons of large wealth or high income" (p. 1091) can all be attributed to a common root. While these same conditions exist in the agricultural sector in Canada, Canadian farmland has not, as yet been characterized as a growth stock.

3. METHODOLOGY

3.1 THE MODEL

3.1.1 Growth: Changes in Land Values

The simplest method of determining whether or not farmland is growing in value is to subtract its beginning value from the end of the year value. The difference is the growth in land values. Only one set of readily available data is needed for the calculation.

However, this method does not facilitate discretization of land value growth into its different sources. These include:

1)Capital gains on farm real estate.

2)Investment in technology or improvements which increase the value of land. These include breaking or clearing, the purchase of irrigation systems, electrical systems, fencing or drainage systems.

3)Growth in the farm business through increased inventories, decreased debt, increased cash or other liquid assets.

4)Inflation in the general economy.

In other words, this method would tend to overestimate growth by including sources other than capital gains.

3.1.2 Growth: Changes in Net Worth

Melichar (1979) solved the dilemma of accounting for growth in farmland values by using a combination balance sheet and income statement as the basis for his analysis of the growth in U.S. farm net worth which he used as proxy for U.S. land values. Adopting this strategy, a Canadian counterpart was designed for this study. There are three distinct parts to the model: the balance sheet, the net investment section and the income statement.

Year by year changes in net worth represent a growth in farm assets. These changes can be readily observed in a financial balance sheet which itemizes assets and liabilities. The value of the owner's net worth on a specific date is calculated by subtracting the value of liabilities from the value of assets at that time.

The balance sheet model used in this study is designed to accommodate available Canadian data. It classifies assets by type instead of by liquidity as is more commonly done. Farm assets are broken into several categories:

1)Farm real estate, a fixed asset which includes the value of land and buildings located on at least one acre and generating at least $250 of agricultural gross sales annually. This is reported in the census.

2)Machinery and vehicles, including implements, machinery, motor trucks and automobiles.

3)Livestock, including livestock, poultry and fur-bearing animals.

4)Other assets, including all current assets such as farmer's stocks, bonds, feed inventories, supply inventories, and crop inventories as well as a small percentage of intermediate and long term non-farm assets.

Liabilities have not been itemized. Ideally, the balance sheet would include a breakdown of current and long term debt; however these data were not available.

In order to isolate changes in net worth which are attributable to real capital gain in farmland values, several adjustments needed to be made (Melichar, 1979). This was done in the investment section. Annual changes in new investment, changes in inventories and changes in levels of liquid assets or liabilities must be subtracted from net worth. Net investment in real estate and machinery consists of capital expenditures less depreciable allowances and accidental damage (Melichar, 1979). The net worth after these adjustments is then representative of nominal or current dollar capital gains.

Theoretically, the adjustments that isolate increases in net worth are a refinement of the farmland capital gains calculation. However, the values required to make these adjustments are not available in Statistics Canada or Taxfiler data. The only available series are offered by the Farm Credit Corporation (FCC) in a form which are only nominally compatible with the Statistics Canada data.

Year by year changes in returns are recorded in the income statement. Usually an income statement is a summary of all income and expenses. For the purposes of this study, only several specific incomes and expenses were included: 1)gross farm rent, which includes both cash and share crop rents; 2)gross farm income which includes cash receipts for agricultural products, income in kind, supplementary payments and value of inventory changes; 3)net farm income, specified as gross farm income minus operating and depreciation charges; 4)interest on debt, the only expense itemized.

It is important to note that net farm income includes only very specific types of income. It does not represent a farmer's total net income since it does not include income from sales of capital assets, pension monies, rental income, interest, or wages. Published data from Statistics Canada shows that in 1976 farm income was 33% of total income; in 1978 it was 26% (Agriculture Canada, 1981, p.53). Therefore neither gross farm income nor net farm income measure the total returns which a farmer receives and upon which his well being depends.

Gross farm rent, as published by Statistics Canada, includes cash and share crop rental income. In order to use gross farm rent as a representative return from farm real estate, a rental value must be extrapolated from the number of acres rented to the total number of acres farmed. The mathematical adjustment is explained in Appendix 1.3.31. The resulting return, imputed rent, is an estimate of the annual cost to the farmer which is paid to a landlord (or in essence to himself if he is an owner/operator) for the use of the productive services of farmland throughout the year. What is a cost on one side of the ledger becomes a return on the other side. Imputed rent is therefore used instead of gross farm rent as a return to farm real estate.

Annual changes in rates of return can be calculated using various sources of income listed in the income statement and comparing these to asset values. These rates of return are, in turn, used to assess:

1)Income generating capacities of capital assets.

2)Asset earnings compared to asset prices.

3)Current income returns compared to annual unrealized capital gains.

4)Returns imputed for management, labor and equity.

5)The magnitude of the economic returns expected as annual returns and capital gains are accumulated.

The completed model, including a balance sheet, net investment calculations, an income statement, plus some analysis is displayed in Appendix 1: Table A1.1 contains Canadian aggregate data, Table A1.2 contains aggregate data for Alberta and Table A1.3 describes each variable as it is used.

3.1.3 Growth: Real Capital Gains

To make an annual comparison of growth, the influences of changes in purchasing power must be accounted for. The Consumer Price Index (CPI) is commonly used as the discounting factor for expressing nominal dollars in real or constant terms. The purpose of this adjustment is threefold:

1)It serves as an economic indicator of the inflation free dollars or rates.

2)It serves as a means to calculate constant, real dollar income.

3)It is used to determine changes in the purchasing power of the dollar.

Henceforth in this study, adjusted dollar terms for any value or rate will be referred to alternately as "real" or "constant". Unadjusted dollar terms will be referred to as either "nominal" or "current".

3.1.3.1 The Consumer Price Index

The Consumer Price Index (CPI) is a Laspeyres, weighted price index measure of the price changes of a fixed basket of consumer goods (Mason, 1982). Use of the CPI as a composite index of commodities and services used by farmers originated with the use, from 1913 to 1970, of a rural index called the Family Living Index. This index included food , clothing, fuel, household equipment, and health maintenance costs, as well as miscellaneous items such as insurance, telephone and tobacco. In 1970, the Family Living Index was replaced as a farm index by the CPI since the consumption of both urban and rural families were becoming increasingly similar.

The method by which values were deflated from nominal to real dollars was:

$$\text{(Current money value)/CPI} \times 100 = \text{real money values} \qquad \text{(Eq. 3.1)}$$

The result was a constant dollar value which can be compared over time with other time series data. The base year for the CPI adjustment was 1981 where 1981=100.

3.1.3.2 Two Methods of Calculating Real Capital Gains

There are at least two ways to approach the calculation of real capital gains. One, the method used by Melichar (1975) and referred to in this study as the Melichar method, first determines nominal capital gains from nominal dollar data and subsequently adjusts them by the change in purchasing power to give real capital gains. The other, is the method derived for use in this study and henceforth referred to as the CMF method, first converts every data series into real dollar values and then calculates real capital gains. Both of these methods have been used in the current work. Conceptually and in their application there are no differences between these procedures although there are some technical dissimilarities.

In Melichar's method of calculation, the calculation of real capital gains from nominal gains can be mathematically expressed as:

$$RCG_{n+1} = \{[(NW_{n+1}-NW_n) - NI_n] - NW_n (-1)[(CPI_{n+1}-CPI_n)/CPI_n]\} \times 100 \qquad \text{(Eq. 3.2)}$$

where:

RCG_{n+1} = real capital gain

n+1 = the current year estimate as of December 31.

n = the previous year estimate as of December 31.

NW = net worth.

NI = net investment.

CPI = the Consumer Price Index.

The first term in Melichar's equation $[(NW_{n+1} - NW_n) - NI_n]$ represents nominal capital gains. It is composed of $(NW_{n+1} - NW_n)$, the change in net worth which has occurred over the year, and (NI_n), the net annual investment. The second term in Equation 3.2, $[NW_n(-1)[(CPI_{n+1} - CPI_n)/CPI_n]]$, conceptually is the annual change in purchasing power of the net worth. The first term minus the second term (nominal capital gains minus annual changes in purchasing power of the net worth) renders real capital gains.

However, in the mathematical calculation of annual changes in purchasing power (real dollar values) of the net worth, the Melichar method adjusts only the beginning of the year net worth values by changes in the purchasing power of the dollar instead of accounting for these changes at both the beginning and end of the year. It also does not adjust any of the individual components of net investment by changes in purchasing power over time. The CMF method makes both of these adjustments.

The CMF method calculates real capital gain directly from data adjusted to reflect real dollar values. It can be expressed as:

$$RCG_{n+1} = [(100/CPI_{n+1}\ NW_{n+1} - 100/CPI_n\ NW_n) - (100/CPI_{n+1}\ NI_{n+1} - 100/CPI_n\ NI_n)] \quad \text{(Eq. 3.3)}$$

This method transforms each variable into constant dollars by using the CPI. By taking ($100/CPI_{n+1}$ NW_{n+1} - $100/CPI_n$ NW_n), the annual change in real net worth year by year and subtracting from this ($100/CPI_{n+1}$ NI_{n+1} - $100/CPI_n$ NI_n), the annual change in real net investment, an annual estimate for real capital gains is calculated. Each variable is consistently transformed into constant dollar form.

The differences between the CMF and Melichar methods of calculating real capital gains cause small variations in the estimates of real growth rates in farm assets and real capital gains estimates for farm assets. These estimates are slightly higher calculated by the CMF method than by the Melichar method. The magnitude of this difference is discussed in Results section 4.2.2.1.

3.2 THE DATA

The data considered best suited to estimating the rate of real capital gains to Canadian farm real estate and to farm assets were census data series collected by Statistics Canada. These data are readily available to the public, are broad in geographic coverage and are detailed in farm related statistics. As used in the models described in Section 3.1, the data are secondary in nature, are a time series and are at the aggregate level for both federal and provincial information.

3.2.1 Secondary data

Statistics Canada data series are widely available and are easily utilized for a study of this kind, as these data are well organized in publications and data bases. Initially, the raw data were collected by

Statistics Canada from farmers across Canada who responded to the census survey. This survey is conducted every five years, concurrently with the national census on the second and seventh years of every decade. Between the most recent census and the coming census year, preliminary figures are released. These yearly estimates are corrected retroactively once the new census has been compiled. Only the corrected, published values have been used in the current work.

All data are reported in dollars. Due to the magnitude of the values, every series is stated in thousands (000) of dollars. The value listed for assets is based on estimates by farmers of the current market value. Actual incomes and liabilities have been reported in their current dollar values.

The secondary data used in this study were gathered for purposes other than evaluating capital gains. There are several sources of nationwide farm financial data: Taxfiler data, Farm Credit Corporation (FCC) data, national farm surveys and other Statistics Canada farmer data. Statistics Canada data were chosen because they report a broader range of information relevant to the entire study than do the other sources even though all had specialized areas of interest that are very clearly reported, including several that contain pertinent information on the farm business.

The choice of relevant variables was as important to this study as the source of data. Except for the new investment and other liquid assets categories, Statistics Canada proved a rich resource for background and peripheral information for continuity in form and length of reporting history. However, even within the Statistics Canada farm series, there was a concern that the sample farm population may have fluctuated in its definition for each census, although there was no way to control potential problems such as this.

3.2.2 Time Series Data

As the purpose of the present study was to observe a pattern of growth in farm real estate and farm asset values over time, the data were by necessity time series in nature, involving an observation of some unit over different points in time. The observation of farms' financial position is made for each year on December 31 on the basis of farm balance sheet and income statements. The unit which is observed in time is an elusive national aggregate farm business based on the sum of individual responses to a particular survey.

When attempting to isolate the cause of changes in value over time in agriculture, the omnipresent influence of technical change must be accommodated. An attempt was made to compensate for the effects of technical change by limiting the time period covered by the study. It is assumed that technical change will have had an insignificant impact on asset values over the period between 1970 and 1986. This time span has been one of the most dynamic periods of farm asset appreciation in the past century.

3.2.3 Financial Data

Financial data are the means by which growth in farm assets is observed. During the search for balance sheet and income statement data, several weaknesses in the Statistics Canada data became apparent:

1)Statistics Canada does not report any of its financial information in the form of a balance sheet. They do report a farm operating income statement. Several series (current, liquid assets, current liabilities, and family withdrawals) are not available.

2)Because the design of a balance sheet is not the purpose for which the data were gathered, there are inconsistencies in the values reported.

3)Data on the adjustment to net worth through new investment, are not available in a form consistent with other data used in the study.

The compromises made in this study because of these data shortfalls can be summed up as follows:

1)In cases when several valuation dates are reported, the one used is the one closest to December 31 for that year. If only one valuation was made for a date other than December 31, it was assumed that this adequately reflected the end of the year valuation. Specific valuation dates for data from Statistics Canada are given in Appendix 1.3.

2)Since data on current assets and liabilities are not available, no empirical assessments of impacts on cash flow can be made.

3)Two important data series, those for new investment and other assets, were based on from FCC data, adjusted to approximate the scale of national data, and incorporated into the model. See Appendix 1.3 for the details of this adjustment.

The value of farmer's other assets are based on data in the annual FCC publication, **Farm Credit Statistics**. These are reported in the table "Average assets, liabilities and net worth after loan per farm unit". This series includes farmers' stocks, bonds, feed supplies, crop inventories, current assets and a small percentage of non-farm long and medium term assets. These data were adjusted from a per-farm basis to a Canada or Alberta wide aggregate by multiplying the per farm figure by the number of census farms. Making this adjustment assumes that the asset holdings of all Canadian farmers are, are of the same composition as are those of FCC borrowers.

The data series on farmers' new investment reported in the FCC table entitled "FCA Loans Approved, by Purpose of Loan" was taken as the basis of new investment for the purposes of this study. The improvements listed by the Farm Credit Statistics are for building, breaking, leveling, irrigation and drainage. To convert the value of these improvements by FCC clients to an aggregate estimate for all Canadian farms, the values of the improvements were divided by the total number of loans approved (from the same FCC table); the quotient was then multiplied by the number of census farms in Canada as reported by Statistics Canada. Making this adjustment assumes that expenditure on farm improvements associated with new investment by all members of the general farm population is the same as for FCC borrowers. The figure does not include public monies which have been spent on agricultural improvements.

In addition to the adjustments involved in imputation of data from FCC data series described above, the Statistics Canada data series have been adjusted to exclude values from Newfoundland. These data were not consistently reported during the period from 1970 to 1986. For example, Newfoundland values for total net farm income, value of inventory change and interest on farm debt have only been reported since 1972; the value of capital has only been reported since 1976 and outstanding farm debt has only been reported since 1981. Values for the Yukon and Northwest Territories are not reported in any of the survey data reported in this study.

3.2.4 Aggregate Data

The data reported in this study represent an aggregation of values for all farmers in the census across Canada or Alberta. Since the data are not available on a cross-sectional basis, financial heterogeneities between farm businesses cannot be detected and attributed to differences in enterprise, location, size, management, entrepreneurial or other skills of a farm owner. For example, the study does not incorporate ways to detect differences in business growth rates, estimate returns or profitability between a 10 acre potato farmer in Prince Edward Island or a 10,000 acre cattle rancher in British Columbia. Rather, interpretation of the results can be made only on a sectorial level.

Aggregation is expected to smooth out heterogeneities in the data, so discussion of the results is in terms of aggregate levels and trends in the data. Nonetheless, it is anticipated that awareness of national and regional trends may be valuable in identifying some of the impacts of changing land and farm asset values on the farm business.

3.3 LIMITATIONS

If the data or the conceptual base of an analysis is incorrect, misspecified or inconsistent it will result in wrong, incomplete or inconsistent conclusions (Heady, 1961). In view of the large body of data from different sources, it is possible that the major limitations to the study may be from errors of data observation and specification rather than errors of conceptualization.

3.3.1 Observational Error

> "People responding to official questionnaires often lie, out of fear of government scrutiny or desire to mislead the competition. 'Nothing like this occurs in nature' - economics is notorious for using second hand data, collected for other purposes, whose logic may be legal or bureaucratic rather than economic. The profits reported on balance sheets may have little to do with real profits. Many official statistical series are completely incompatible with one another" (Kuttner, 1985, p. 79).

Errors of observation such as those referred to by Kuttner include those that may have occurred during the initial transcription or initial documentation and the final transcription into the data set of this study. The bias which observational error may have introduced into the study cannot be identified.

3.3.2 Specification Error

Specification bias may arise due to the need to compromise or use less than ideal methods or variables. This need stems from a lack of pertinent data or from incorrect or inadequate variables. As a result of the need to compromise, assumptions are made, approximations are substituted for actual figures and methods are adapted.

Possible specification problems of the data used in the study are outlined in this chapter (Chapter 3: Methodology) and in Appendix 1.3. In addition, Appendix 1.3 details the adjustments made in the data to overcome the problems of data compatibility discussed in this chapter.

3.3.3 Conceptual Error

In agricultural economics, as in other evolving fields, there is often disagreement among the discipline's authorities concerning current issues. Theories on farm land evaluation and appreciation have been subject to scrutiny and discussion for some time. By taking Melichar's (1975) methods as a model for this study, the results may be biased toward many of Melichar's basic interpretations.

4. RESULTS AND DISCUSSION

4.1 IS CANADIAN OR ALBERTA FARMLAND A GROWTH STOCK?

Despite shorter term fluctuations, for the past 60 years, the value of Canadian farm real estate have tended to exhibit an upward trend. However, since 1970, much volatility in the land market has been noted. This section of the study focuses on growth in farm real estate values, identifies the functional form of these changes and explains different methods of quantifying the growth rate.

4.1.1 Real Estate Values, 1926 to 1986.

Since 1926 when Statistics Canada began annual reporting of land and building values, farm real estate has been changing in value. Figure 4.1 shows these changes in value both in current year dollars and constant (1981) dollars. (The values are listed in Appendix Table 2.1). The constant dollar value of Canadian farm real estate rose from $25.3B (Billion) to $63.0B in the interval between 1926 and 1986. The largest increase took place during the last 17 years, from 1970 to 1986. The value of Canadian farm real estate in 1971 was 39.8% of its peak 10 years later. By 1984, however, farm real estate values had fallen to the same levels as in 1978; by 1986 values had fallen to their 1976 levels. Over the past several years, farm real estate values in Canada have fallen at the same rate as they previously rose to the 1981 peak (Figure 4.1). However, the 1986 constant

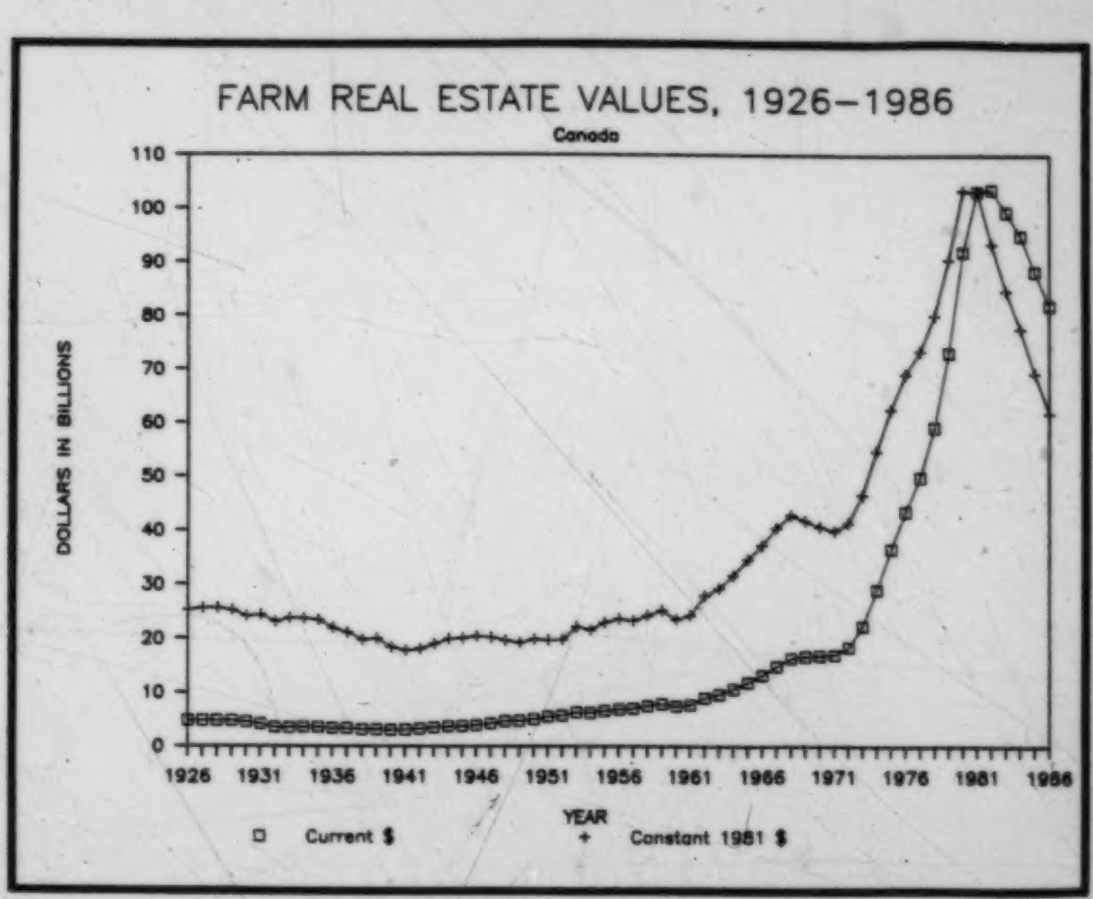


Figure 4.1 Farm real estate values, 1926-1986. Aggregate Canadian farm real estate values expressed in both nominal and real dollar values, illustrating the changes in land values which have occurred between 1926 and 1986. Canadian values include figures for all provinces and territories. The real dollar values were found by adjusting the nominal levels by the average Consumer Price Index (CPI) where 1981=100. The source of farm real estate data is Statistics Canada Cat. No.21-603E and are listed in Appendix Table A2.1.

dollar values were still 1.5 times higher than the 1970 level.

4.1.2 Growth in Real Estate and Other Farm Assets

Growth in asset values can be simply defined as a change in value at a rate different than the general inflation rate (Huff and Cusack, 1972; Tweeten, 1981). Indexing the value of farm assets, liabilities and returns relative to their respective 1981 constant dollar values gives for each a percentage change in value regardless of original magnitude or of general inflation rates. Table A3.1 in Appendix 3 reports the resulting indexed values of various farm assets and farm incomes as a percentage of their constant dollar value in 1981.

Scrutiny of values for farmland, farm real estate (farmland and buildings) and total farm assets indicates that composition has had an effect on the different rates of growth in value that can be observed in Figure 4.2. Land values have grown more rapidly than has the value of farm real estate (land and buildings) which in turn has grown more rapidly than total farm asset values (land, buildings, machinery, livestock and liquid assets).

Note that if the trend in the growth rate was horizontal for any variable depicted in Figure 4.2, this would indicate that the rate of growth had been equal to the rate of general inflation. Real estate values, farm land values and the value of total farm assets changed at a rate very close to the rate of inflation during the two periods of 1970 to 1971 and 1980 to 1981. However, other than during these four years, all three variables have exhibited rates of change -- both positive and negative -- that have varied

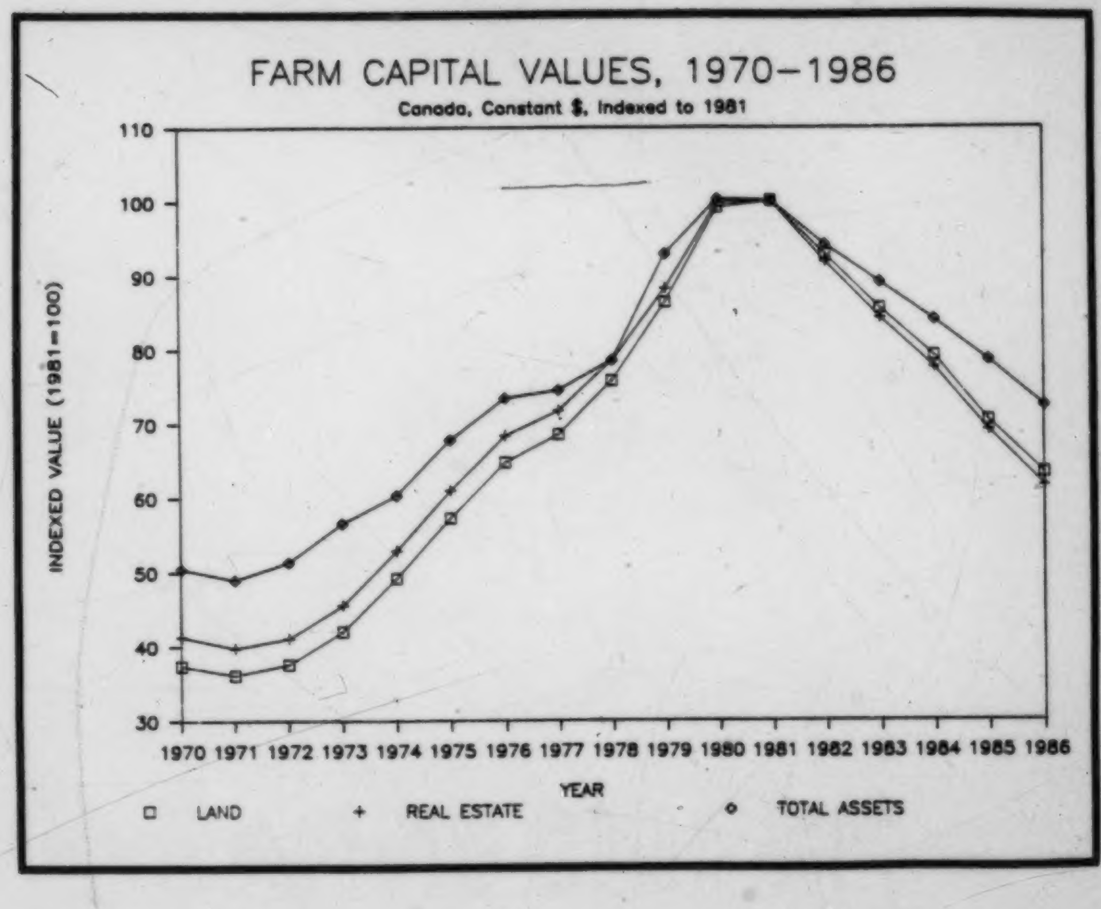


Figure 4.2 The value of farm land, farm real estate and total farm assets, 1970-1986. Aggregate Canadian values of land alone (land), land and buildings (real estate) and farm assets (total assets) are expressed as a percentage of their 1981 value in order to compare trends irrespective of differences in magnitude. Note that land rose more steeply than real estate or total assets, while farm real estate fell the most rapidly from its 1981 high. Values expressed as indexes in constant 1981 dollars. Source: Statistics Canada Cat. No. 21-603E; also listed in Table A1.1.

from the rate of inflation. Periods during which asset values were increasing in value more rapidly than was the general inflation rate occurred from 1971 to 1981. Declines occurred in 1970 and from 1981 to 1986.

Figure 4.2 illustrates the constant dollar, index of values of farm real estate, farmland and farm assets. The data on which this figure is based are found in Appendix 3. The similarity in direction shapes and amplitude of each of the three curves is reflective of an overlap in asset composition. In Canada, land averages 65.2% of total farm real estate and 41.8% of total farm assets. Farm real estate averages 64.0% of total farm assets. Asset composition in Alberta shows a similar pattern: land value averages 71.3% of farm real estate value and 47.9% of total farm asset value. Farm real estate averages 67.2% of total farm asset values.

In the seventeen year interval from 1970 to 1986, there have been 9 years of positive growth, 6 years of negative growth and 2 years of no growth in the values of farm real estate. Overall there has been an increase in farm real estate values of nearly 150 percent (2.41 times) over the 17 year period of study. Based on these observations, growth in farm real estate in both Canada and Alberta has been consistently different than the general inflation rate. These growth rates suggest that farmland may be characterized, at least qualitatively, as a growth stock.

4.1.3 The Best Fitting Functional Form.

In order to describe the historical patterns in farm real estate values and the change in values of real estate between 1970 and 1986, a best fitting functional form was found by applying polynomial regressions to the time series data of constant dollar farm real estate values. The first derivative of that line, the functional growth in farm real estate, was also calculated to determine whether or not it would closely match the actual growth in real estate calculated from Statistics Canada data. Figure 4.3 illustrates the relationship between the actual and regression predicted estimates of farm real estate values and growth in farm real estate values.

The functional form which best described the historic trend of the real value data was a cubic polynomial (of the general form: $y = ax^3 + bx^2 + cx + d$). This equation was:

$$y = -81790t^3 + 1683626t^2 - 4169927t + 41376146 \qquad \text{(Eq. 4.1)}$$

where:

y = farm real estate values. $R^2 = 0.97$

t = time in years

The implications of finding this form as the best fit function are threefold. First, it means that the historical pattern in farm real estate values is cubic. Second, it means that the growth in farm real estate values during the period 1970 to 1986 has been quadratic. Third, it means that the historical rate of growth in farm real estate values has been linear. What these three findings therefore suggest is that while the CAPM capitalization formula ($V = I/r$) estimation of land values is linear, historical trends (1970 to 1986) in farm real estate values have followed a cubic pattern.

Each of the three functional forms, cubic, quadratic and linear, imposes different mathematical constraints in describing the historical growth in constant dollar farm real estate values. Use of a linear trend describes the average change in farm real estate values over the period from

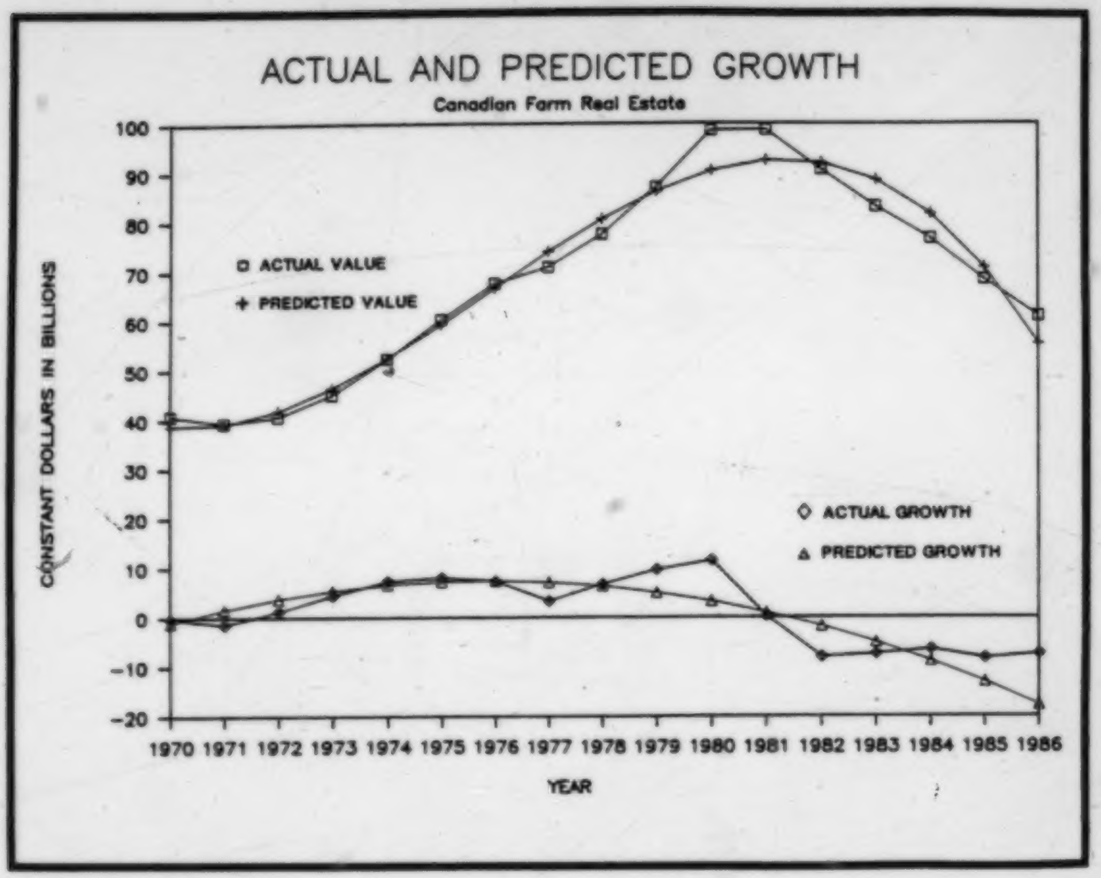


Figure 4.3 Actual and predicted values of farm real estate, 1970-1986. Actual values of farm real estate and those predicted by a polynomial (cubic) regression are shown for the time period that this regression was fitted. In addition, the actual values of growth in farm real estate and those calculated by taking the first derivative of the cubic form are shown beneath farm real estate values. The actual values of farm real estate (Canadian farm land and buildings) are found in Statistics Canada Cat. No. 21-603E and are listed in Table A1.1. The regression analysis is discussed in Appendix 4. The real dollar growth in farm real estate values is listed as real capital gains on real estate in Table A1.1.

1970 to 1986. When the linear model was fitted to the historical data from 1970 to 1986, the model only explains a maximum of 53% of the variation in farm real estate values. In this case, the rate of growth in farm real estate is constant, a feature that fails to describe the substantial rise and fall in values which were experienced in both Canada and Alberta from 1970 to 1986. Similar difficulties apply with the use of the quadratic form. In this case 77% of the change of farm real estate values is explained by the functional form. Implicit in the use of a quadratic model is that the growth in farm real estate is linear and that the rate of growth increases or decreases by a constant value. In contrast, the cubic model which best describes the historical pattern in farm real estate values from 1970 to 1986, implicitly suggests that growth in farm real estate values is quadratic in form and the rate of growth in farm real estate values during the study period is linear and thus not constant over time. Further details are discussed in Appendix 4. However, such functional forms are only descriptive of the pattern of historical values and therefore they do not aid in predicting future economic trends.

Actual growth rates, calculated by taking the difference between the land value at the end of one year minus that at the end of the previous year, indicate that the minimum real value for farm real estate was in 1970, following several years of negative growth in the late 1960's. The maximum real value for farm real estate was in 1981. This heralded the decline in land values seen in the early 1980's. Capital gains were experienced during 9 years out of the period from 1972 to 1981 while capital losses were experienced during 7 years of the study (in 1970 and from 1981 to 1986). Overall, rates of growth in Canadian farm real estate values were constant and negative for 4 years during the 17 year period. This was from 1982 to 1984 and in 1986. In one year (1981) growth in values of Canadian farm real estate was zero.

4.2 ANNUAL GROWTH MEASURES

The quantification of growth in Canadian farmland actually involves the calculation of three types of growth. These include growth in farm real estate, growth in farm assets and growth in farm equity. All three focus on slightly different areas of the return to investment.

Growth in farm real estate is what an investor might use to estimate annual changes in real estate values simply by subtracting the value of the land value in one year from the previous year's value. However, since 64.0% of Canadian farm capital is tied up in farm real estate, changes in real estate value will also be closely related to growth in farm assets and farm business growth.

Growth in farm assets is the combination of changes in asset values due to new capital investment and to capital gains. Growth in farm equity, measuring changes in net worth, is commonly recognized as a measure of business growth. However, it is not always clear whether this growth in equity occurs as a result of asset growth or because of other changes in net worth.

Table 4.1 summarizes and Figure 4.4 illustrates the estimated growth in each of the three measures. In addition, nominal and real growth rates were calculated; the former is listed in the upper half of the table, the latter in the lower half. For the purpose of comparison, both Melichar's

CANADA:

YEAR	GROWTH IN REAL ESTATE (NOMINAL)	GROWTH IN EQUITY (NOMINAL)	GROWTH IN FARM ASSETS (NOMINAL)
1970	0.007	0.037	-0.039
1971	0.010	0.010	-0.023
1972	0.085	0.109	0.077
1973	0.212	0.216	0.163
1974	0.305	0.201	0.223
1975	0.263	0.236	0.166
1976	0.187	0.145	0.157
1977	0.148	0.107	0.152
1978	0.186	0.136	0.159
1979	0.234	0.319	0.224
1980	0.258	0.212	0.205
1981	0.123	0.115	0.108
1982	0.003	0.018	0.011
1983	-0.041	-0.023	-0.028
1984	-0.044	-0.027	-0.031
1985	-0.070	-0.033	-0.053
1986	-0.072	-0.052	-0.051

YEAR	GROWTH IN REAL ESTATE[a] (REAL)	GROWTH IN EQUITY[b] (REAL)	GROWTH IN FARM ASSETS[c] (REAL) CMF method	GROWTH IN FARM ASSETS[d] (REAL) Melichar
1970	-0.008	0.022	-0.055	-0.054
1971	-0.037	-0.037	-0.088	-0.072
1972	0.032	0.056	0.024	0.021
1973	0.109	0.112	0.085	0.050
1974	0.162	0.069	0.088	0.075
1975	0.153	0.128	0.058	0.048
1976	0.121	0.081	0.090	0.089
1977	0.049	0.011	0.048	0.047
1978	0.085	0.051	0.084	0.084
1979	0.124	0.201	0.105	0.085
1980	0.132	0.080	0.078	0.069
1981	0.001	-0.005	-0.018	-0.027
1982	-0.082	-0.068	-0.080	-0.083
1983	-0.083	-0.065	-0.078	-0.073
1984	-0.079	-0.083	-0.088	-0.098
1985	-0.109	-0.073	-0.094	-0.085
1986	-0.109	-0.090	-0.080	-0.081

Table 4.1 Measures of growth in the farm sector between 1970 and 1986. Three measures of growth are calculated: growth in farm real estate values, growth in the value of equity in farm assets and growth in the value of farm assets. The growth rates are all calculated from aggregate, nominal and real dollar values of Canadian and Alberta data.

a) Real estate values, consisting of land and buildings, are found in Statistics Canada Cat. No. 21-603E. They are listed in Appendix Tables A1.1 and A1.2 and described in Appendix1.3. Growth in real estate is the annual change in real estate value calculated by: [(end of year value/beginning of year value) - 1].

b) Equity values are calculated by subtracting annual aggregate values of total farm liabilities from annual aggregate values of total farm assets. These are listed in Appendix Tables A1.1 and A1.2 and described in Appendix 1.3. Growth in equity is the annual change calculated by : [(end of year value/ beginning of year value) - 1].

Table 4.1 continued.

ALBERTA:

YEAR	GROWTH IN REAL ESTATE (NOMINAL)	GROWTH IN EQUITY (NOMINAL)	GROWTH IN FARM ASSETS (NOMINAL)
1970	-0.009	0.030	-0.042
1971	-0.001	0.005	-0.038
1972	0.174	0.149	0.141
1973	0.250	0.248	0.210
1974	0.346	0.241	0.254
1975	0.294	0.234	0.171
1976	0.186	0.157	0.154
1977	0.178	0.130	0.165
1978	0.193	0.169	0.178
1979	0.417	0.455	0.377
1980	0.282	0.237	0.236
1981	0.104	0.078	0.086
1982	0.010	0.038	0.010
1983	-0.080	-0.040	-0.049
1984	-0.070	-0.069	-0.059
1985	-0.060	-0.036	-0.054
1986	-0.080	-0.032	-0.059

YEAR	GROWTH IN REAL ESTATE^a (REAL)	GROWTH IN EQUITY^b (REAL)	GROWTH IN FARM ASSETS^c (REAL) CMF method	GROWTH IN FARM ASSETS^d (REAL) Melichar
1970	-0.023	0.015	-0.057	-0.057
1971	-0.047	-0.042	-0.085	-0.087
1972	0.117	0.094	0.084	0.082
1973	0.144	0.142	0.103	0.095
1974	0.199	0.105	0.110	0.102
1975	0.172	0.127	0.061	0.053
1976	0.120	0.093	0.086	0.086
1977	0.077	0.033	0.057	0.058
1978	0.101	0.078	0.080	0.081
1979	0.290	0.325	0.242	0.235
1980	0.153	0.112	0.103	0.097
1981	-0.015	-0.038	-0.041	-0.045
1982	-0.076	-0.050	-0.085	-0.086
1983	-0.101	-0.081	-0.094	-0.093
1984	-0.104	-0.103	-0.096	-0.094
1985	-0.089	-0.076	-0.096	-0.096
1986	-0.117	-0.071	-0.098	-0.099

c) Growth in farm asset values, a measure of capital gain in farm asset values, is calculated by subtracting net investment from annual changes in owner's equity (i.e. net worth) of farm assets. The results of these calculations are listed in Appendix Table A1.1 and A1.2 and described in Appendix 1.3.

d) CMF and Melichar methods of calculating real capital gain in farm asset values differ in a minor technicality of discounting dollar values by the CPI. These two methods are discussed in Chapter 3.

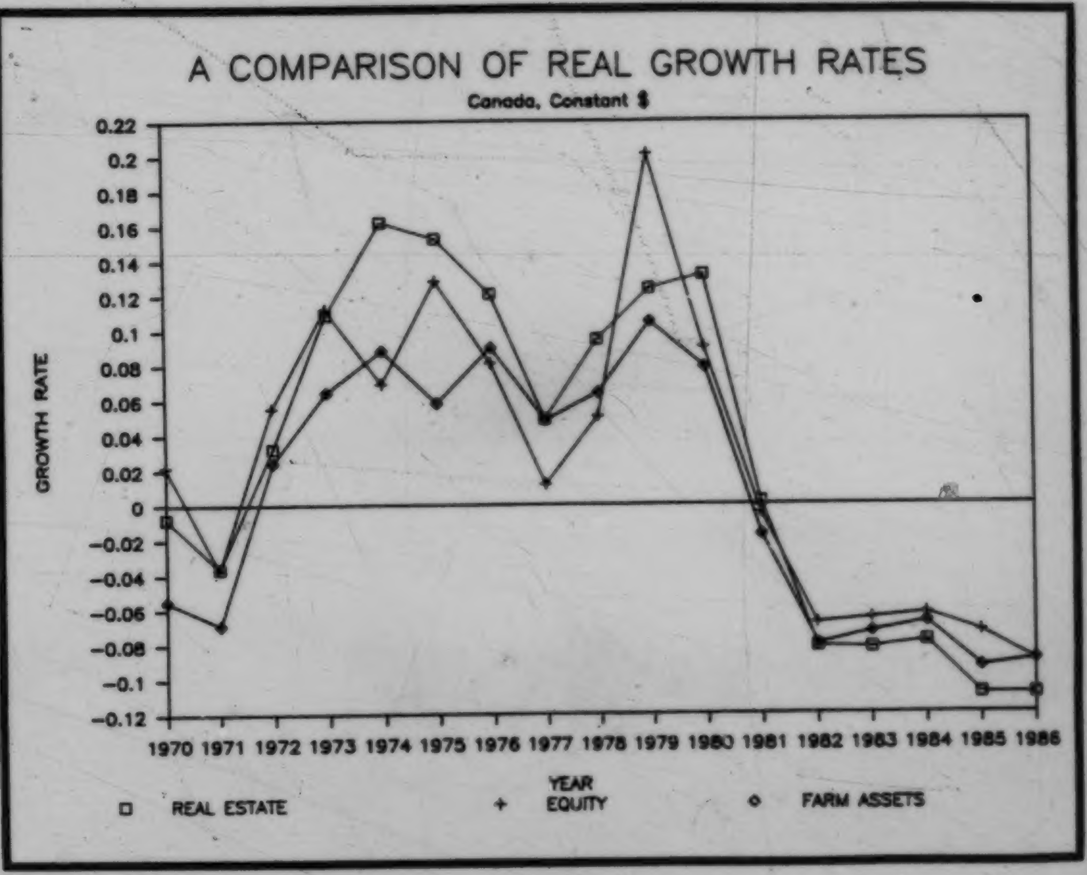


Figure 4.4 Growth rates in real dollar values of Canadian farm real estate, equity in farm assets, and total farm assets from 1970 to 1986. Despite being measurement of very different aspects of farm growth, these variables displayed similar growth rates over the seventeen year period. Growth in farm real estate was taken as annual difference in the real value of land and buildings; equity in farm assets as annual changes in net worth of real estate, machinery, livestock and liquid assets; and growth in farm assets (net worth minus net investment) as a measure of the real capital gain in farm assets. These values are listed in Table 4.1. and are derived from aggregate Canadian data.

(1979) formulation of farm asset growth and the CMF estimate (discussed in Chapter 3: Methodology, section 3.1.3.2) were also calculated.

4.2.1 Farm Real Estate

Table 4.1 shows that the annual rate of growth in nominal values of Canadian farm real estate ranged from a high of 30.5% in 1974 to a low of -7.2 in 1986. In Alberta, the rate of nominal growth ranged from a high of 41.7% in 1979 to -8.0% in 1986. For four years, 1983, 1984, 1985 and 1986, nominal growth in farm real estate was negative. In addition, in Alberta, 1970 and 1971 were also years of negative nominal growth.

In real terms, the annual growth rate in Canadian farm real estate ranged from a high of 16.2% in 1974 to a low of -10.9% in 1985 and 1986. In Alberta the high growth rate was 29.0% in 1979 and the low was -11.7% in 1986. In both Canada and Alberta, real dollar annual farm real estate capital losses have been from 8% to 11% during the four years of falling values, 1983-1986. The rates at which capital losses are occurring have increased in each successive year.

The real rates of growth in Canadian farm real estate were roughly half of the nominal rate. They were also roughly 2% to 3% less than were the real annual aggregate capital gain or loss from farm real estate in Alberta.

4.2.1.1 Nominal and Real Growth

When nominal rates of growth in farm real estate values (shown in Table 4.1) follow the trends in real growth but are 1/3 to 5 times higher than real growth rates, an investor who does not make adjustments to exclude the effects of inflation will suffer from "money illusion", the magnitude of which is apparent in Figure 4.5. By using nominal instead of real growth rates for either future or past estimations of returns, he would consistently overestimate rising growth rates and underestimate falling growth rates. At the peak of high growth rates for farm real estate, nominal rates overestimate real growth rates by 53% to 70%. At the trough in growth rates, when growth rates were their most negative, nominal rates of farm asset growth underestimated real growth rates by 1.5 times.

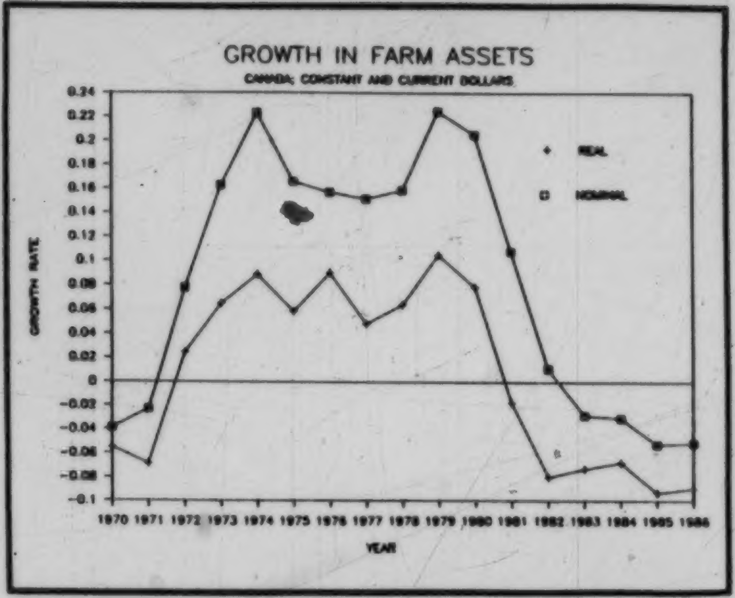
Figure 4.5 graphically illustrate the magnitude of these deviations in real and nominal growth rates for values of Canadian farm real estate as well as farm assets and aggregates farmers' equity in farm assets.

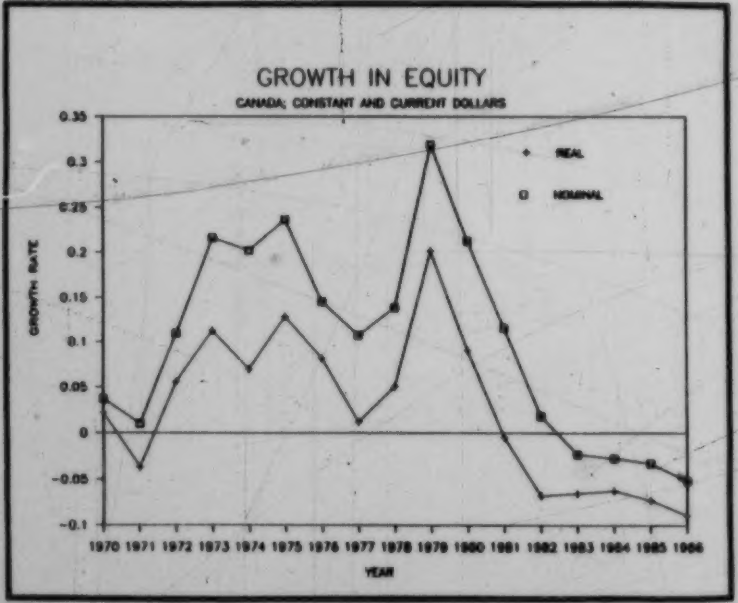
4.2.1.2 Growth in Real Estate in Canada and Alberta

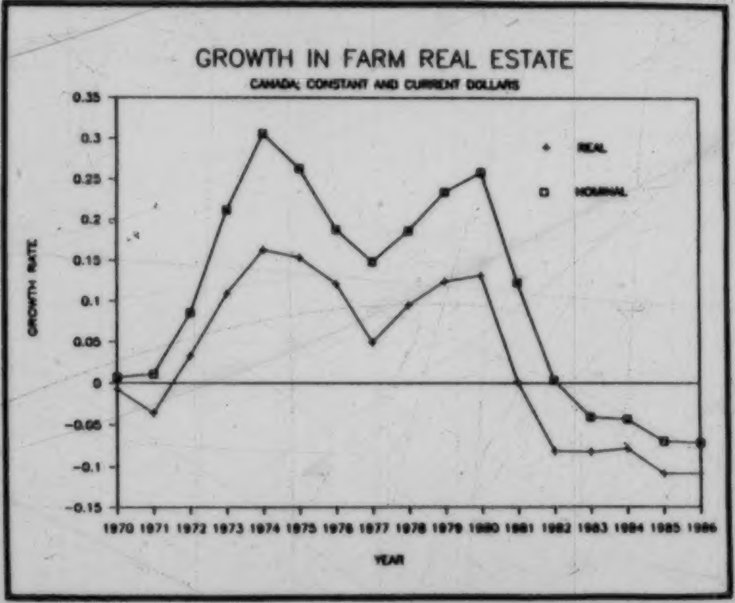
Rates of growth in farm assets, farm net worth and farm real estate exhibited higher highs and lower lows in Alberta than for Canada as a whole. This volatility in the data for Alberta likely occurs because the Alberta data represents only a sample of the data for the Canadian aggregate figures and are therefore less influenced by the smoothing effects of aggregating nationwide groups of farming enterprises.

The Alberta values may have been more influenced by the effects of local economic and geographic differences that would not have been felt in the total farming population. For example, growth in farm real estate peaked in Canada in 1974. In Alberta this peak did not occur until 1979. In addition, Alberta may have been experiencing more volatile agricultural growth than was the rest of the country due to its unique resource-based

Figure 4.5 Real and nominal dollar rates of growth in Canadian farm assets, 1970-1986. Shown are the rates of growth in farm real estate (the annual change in value of land and buildings), equity in total farm assets (the annual changes in net worth of real estate, machinery, livestock and liquid assets) and farm assets (the annual change in net worth minus net investment as a measure of capital gain in farm assets). Individual trends in growth rates in aggregate Canadian values for each of the three growth measures were graphed directly from values listed in Table 4.1. The magnitude of potential "money illusion" which occurs if real and nominal dollar values are not clearly distinguished becomes apparent when these dollar terms are plotted together.







economy and much dependence on grain prices, both factors which exhibited dramatic swings between 1970 and 1986 that could have had more effect on the provincial situation than on the national aggregate farm balance sheet.

4.2.2 Farm Assets

From Figure 4.4, it is apparent that annual growth in farm assets has been consistently less than growth in farm real estate. Farm assets and farm equity closely follow trends in farm real estate. Each series shows 9 years of positive growth and 8 years of negative growth. Both 1974 and 1979 were years of large increases in the value of farm assets in both Canada and Alberta.

For the five years from 1982 to 1986, farm assets actually grew at a less negative rate than farm real estate. During this period, growth in farm assets was buoyed by growth in value of its non-real estate components.

4.2.2.1 Methods of Calculating Growth in Farm Assets

The results of two techniques for calculating farm asset growth are shown in the bottom half of Table 4.1. As was discussed in Methodology 3.1.3.2, the conceptual base of the CMF and Melichar techniques is identical. These techniques differ only slightly due to a technicality in the discounting adjustment. As can [illegible] seen in Figure 4.6, the empirical differences in the two techniques were found to be negligible.

Using CMF method of discounting, annual rates of nominal farm asset growth in Canada ranged from the high levels of 22.4% in 1979 and 22.3% in

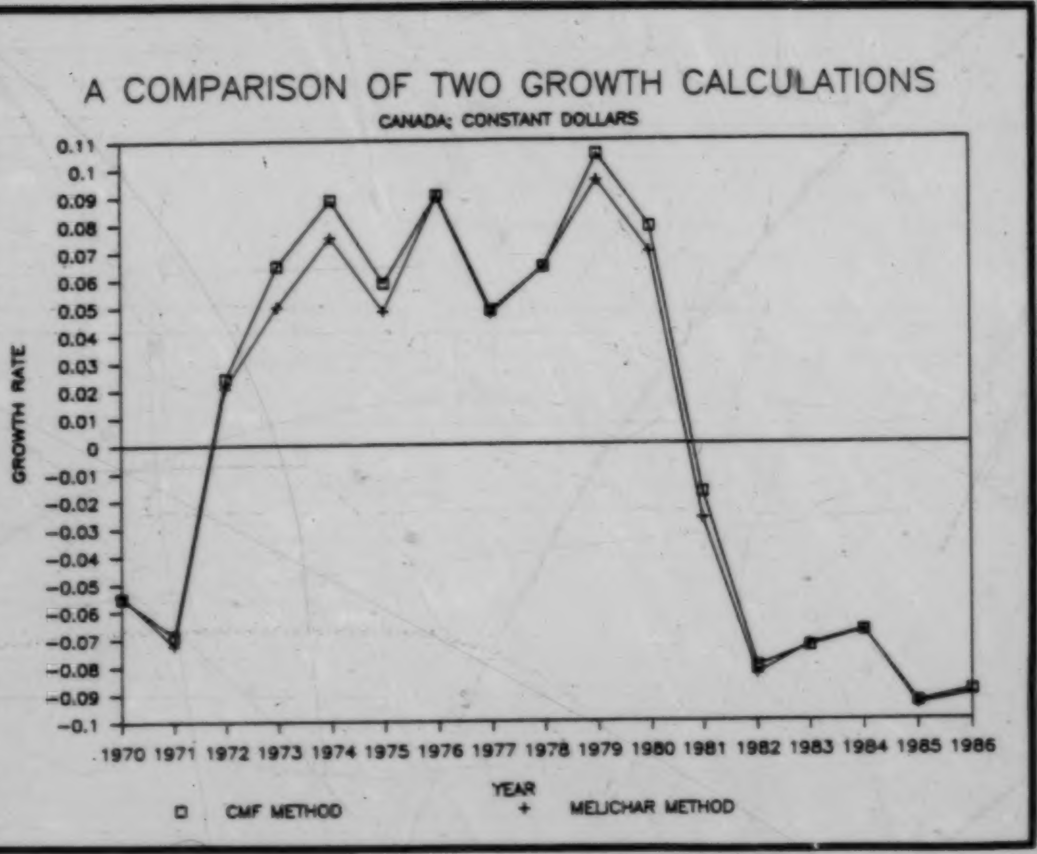


Figure 4.6 The CMF and Melichar methods of calculating growth rates in Canadian farm asset values. The growth rates shown represent real capital gains in the aggregate value of farm assets between 1970 and 1986. The CMF method uses real dollar data to calculate real capital gains as farm net worth minus net annual investment. In the Melichar method, nominal dollars are used to calculate nominal gains and are then adjusted by the CPI to real dollar terms, yielding real capital gains. The technical difference between these two methods is that the CMF method discounts all variables similarily whereas the Melichar method does not discount the begining of the year net worth or the components of net investment (discussed in Chapter 3, section 3.1.3.2). However, it is clear that only small differences exist in the values calculated by each of the methods. Values for both variables are listed in Table 4.1.

1974 to a low of -5.3% in 1985. The results for Alberta were a nominal high of 37.7% experienced in 1979 which ranged to a period low of -5.9% in both 1984 and 1986.

Trends in farm asset value growth were nearly as variable as nominal growth rates during the seventeen years covered by the study. In Canada the rate at which farm assets grew in value ranged from 10.5% in 1979 to -9.4% in 1985. In Alberta real rates of growth in farm assets were similar to those in Canada but the timing of their high-low peak values was different than in Canada. The high rate of farm asset growth (of 11.0%) was experienced in 1974, not 1979 as in Canada. The low (of -9.8%) was one year later in Alberta than in Canada (1986 vs. 1985). Negative growth, even at half of this rate, had not been experienced since 1970 and 1971. However, in Alberta, it was -8% to -10% per year for four years from 1982 to 1986.

The results for Canada using the Melichar discount technique deviate by 1.0% of the CMF method results with the exception of 1973 where the Melichar growth for farm asset values was 1.5 percentage points less than the CMF estimate. For Alberta, the two estimates reported in Table 4.1 are nearly identical. It can be clearly observed in Figure 4.6 that the Melichar model consistently resulted in slight underestimates of capital gains and slight overestimates of capital losses as compared to the CMF method. However these differences are very small.

4.2.2.2 Using Farm Assets as a Proxy for Farm Real Estate

Farm assets were used as a proxy for farm real estate by Melichar (1979) who justified this assumption on the basis that the latter comprised 80% of U.S. farm assets. In Canada the situation is clearly different.

First, farm real estate observed in Canada (Figure 4.4) averaged 64.0% of farm asset values. In Alberta the farm assets are only 67.2% real estate. The assumption that farm assets are composed almost entirely of farm real estate is therefore untenable in both Canada and Alberta. Secondly, using growth in farm assets as a proxy for growth in farm real estate would tend to underestimate growth in Canada and Alberta by roughly one third. An underestimation of this magnitude would tend to bias the estimation of existing growth rates in farm real estate values.

4.2.3 Growth in Farm Business Equity

Trends in equity growth may be seen in Figure 4.6. For 10 years of the study period, specifically in 1970 and from 1972 to 1980, growth in equity was positive. For another 7 years including 1971 and from 1981 to 1986, real dollar equity has been declining in the Canadian sector at rates that range from 6.5% to 9.0% per year.

The value of equity in farm assets influenced by many factors. Changes in farm equity, both positive and negative, are considered as either business growth or business decline. In a working paper, "A Partial Solution to the Current Problem in Agricultural Credit", Aukes (p.3) lists the following reasons for negative business growth:

1. Falling asset (land) prices.
2. Large interest payments on debt other than operating debt.
3. Below par performance of a farm manager in terms of production and marketing.
4. Unanticipated production difficulties such as drought or an early frost.
5. Unusually high family withdrawals of capital from the business.

It is likely that many of these factors have likely had a role in the negative business growth exhibited in both Canada and Alberta. In 1971, for example, the aggregate farm business experienced a decline which was associated with the lowest asset values evident during the entire 17 year period. In the period 1981 to 1986 negative business growth was again associated with falling asset values. Also evident during these six years were interest payments on debt in real dollar terms which had reached their peak in 1981; real gross farm incomes which had fallen between 1982 and 1984; and drought in Alberta from 1983 to 1985.

During the 10 years that farm business grew, farm real estate values appeared to be a major controlling factor. Kay (1981) lists several other reasons for stimulated business growth:

1. Rising asset (land) values.
2. Additional capital investment.
3. Personal capital added to the business by the owner (i.e. an off-farm income, gifts, inheritances).
4. The business generates a profit which is reinvested in the business.

In a growing business, the value of net worth should be increasing without the benefit of inflating real estate values. In 1979 this situation clearly occurred. As can be seen in Figure 4.5, 1979 was a year of both record growth in both farm equity and farm real estate values. However, in that one year equity in Canadian farm businesses grew by 21.1% (in Alberta growth was 33.4%) while farm real estate values grew by only 13.3% (in Alberta by 30.1%).

Farmers wanting to know if their management efficiency or increased productivity contributed to business growth would often have been be frustrated to find that these factors are indistinguishable from the influence of real estate appreciation and depreciation. Contributions of rising real estate values to net worth can disguise an unproductive or inefficient farm business during years of positive real estate growth and rapidly erode equity in years of negative growth. Keeping an "at cost" base balance sheet instead of an "at market" base is one way of distinguishing between the two sources of growth in net worth.

Despite different purposes and origins, the growth rate reported in Table 4.1 share some common features. Farm equity, real estate values and assets growth all occur within the same order of magnitude except during the three years of 1970, 1971 and 1975. During the periods of falling growth rates (1981-1984), the three rates are very similar.

The growth rates illustrated in Figure 4.5 show a bimodal pattern with the first peak occurring in 1974, a trough in 1977, a second peak in 1979-1980 and another trough in 1982. Both farm asset and farm real estate growth rates were trimodal -- peaking twice between 1973-1976 and again in 1979-1980. However these growth rates were still very similar to the trends in equity.

From Figure 4.5 positive and negative growth rates can be seen exhibited simultaneously by all three types of indicators. Negative growth increased at an increasing rate in 1970-1971, 1981-1982 and 1984-1985. Positive growth rates occurred at increasing rates from 1971 to 1974 and 1977 to 1979, while changing at decreasing rates from 1974 to 1977 and 1979 to 1979. While the general trends in each indicator were similar, the individual indicator used as a measure of growth is critical to the delineation of a specific growth rate. The different measures may vary by as much as two to three times between lowest and highest estimate of growth rates in farm real estate, farm assets and farm equity.

4.3 RETURNS TO OWNING FARM REAL ESTATE

An investor's decision as to whether or not to purchase or hold a growth stock depends on his perception of an acceptable rate of return. It is also influenced by his need for long term, intermediate term or short term returns on the investment. The total return to investment in a growth stock such as farm real estate is composed of the two parts that were previously discussed, current returns and capital gains (section 2.6.2).

4.3.1 Annual Returns to Farm Real Estate

Low rates of annual return are characteristic of growth stocks. From the calculated rates of return in capital gains, annual income and overall realized return reported in Table 4.2, it can be seen that Canadian real dollar imputed rental return to farm real estate averaged 2.3% of farm real estate values over the period 1970 to 1986. Imputed rent, the annual return to ownership on farm real estate, ranged from a high of 3.0% in 1974 to a low of 1.8% which applied in 1982. In the years from 1984 and 1985 the the annual return rose slightly to 2.0%.

In Alberta aggregate rental returns were similar. These rental returns averaged 2.1% of farm real estate values, ranging from a high of 3.5% in 1973 to a low of 1.4% in 1981-1982.

CANADA:

YEAR	RETURNS TO FARM ASSETS: NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	NOMINAL ANNUAL RETURN[c]	REAL ANNUAL RETURN[d]	IMPUTED NOMINAL RETURN[e]	IMPUTED RATE OF REAL RETURN[f]	RETURN TO FARM REAL ESTATE: NOMINAL CAPITAL GAIN[g]	REAL CAPITAL GAIN[h]	ANNUAL RETURN: IMPUTED RENT[i]	REAL ANNUAL RETURN: IMPUTED RENT[j]	IMPUTED NOMINAL ECONOMIC RETURN[k]	IMPUTED REAL ECONOMIC RETURN[l]
1970	-0.033	-0.047	0.047	0.046	0.014	-0.000	0.007	-0.008	0.024	0.024	0.031	0.016
1971	-0.020	-0.059	0.051	0.048	0.031	-0.010	0.010	-0.037	0.027	0.025	0.037	-0.012
1972	0.065	0.020	0.057	0.054	0.123	0.075	0.085	0.032	0.027	0.026	0.112	0.057
1973	0.138	0.055	0.097	0.089	0.235	0.144	0.212	0.109	0.027	0.025	0.239	0.128
1974	0.191	0.076	0.090	0.080	0.281	0.156	0.305	0.162	0.034	0.030	0.339	0.178
1975	0.143	0.050	0.087	0.079	0.229	0.129	0.260	0.153	0.031	0.028	0.293	0.173
1976	0.135	0.078	0.058	0.055	0.194	0.133	0.187	0.121	0.027	0.025	0.214	0.144
1977	0.131	0.042	0.043	0.039	0.174	0.081	0.148	0.049	0.024	0.022	0.172	0.063
1978	0.136	0.055	0.049	0.045	0.185	0.100	0.186	0.085	0.025	0.023	0.221	0.112
1979	0.192	0.080	0.050	0.045	0.242	0.135	0.234	0.124	0.026	0.023	0.260	0.139
1980	0.178	0.068	0.036	0.032	0.214	0.100	0.258	0.132	0.026	0.023	0.284	0.143
1981	0.095	-0.016	0.046	0.041	0.141	0.025	0.123	0.001	0.022	0.020	0.145	0.009
1982	0.010	-0.070	0.033	0.030	0.042	-0.041	0.003	-0.092	0.020	0.018	0.023	-0.070
1983	-0.025	-0.064	0.024	0.023	-0.000	-0.040	-0.041	-0.083	0.020	0.019	-0.021	-0.064
1984	-0.027	-0.058	0.029	0.028	0.003	-0.030	-0.044	-0.079	0.021	0.020	-0.023	-0.059
1985	-0.045	-0.080	0.035	0.034	-0.010	-0.046	-0.070	-0.109	0.021	0.020	-0.049	-0.090
1986	-0.043	-0.078	0.046	0.044	0.003	-0.031	-0.072	-0.109	0.020	0.019	-0.052	-0.090

Table 4.2 Rates of return to farm assets and farm real estate in Canada and Alberta, 1970 to 1986. The retdrns shown are the nominal dollar and real dollar rates of capital gain in aggregate values of farm assets and farm real estate; annual returns from owning farm assets and farm real estate (i.e. gross farm income and rental income), and imputed economic rates of return when both aggregate capital gains and annual incomes are considered as an annualized income stream. Individual variables are described in Appendix 1.3.

a) Rate of nominal capital gain on farm assets is calculated by dividing nominal capital gains on farm assets (the difference between net worth and net investment) by the beginning of the year value of total farm assets.

b) Rate of real capital gain on farm assets is calculated by dividing real capital gains on farm assets (the real dollar difference between net worth and net investment) by the beginning of the year value of total farm assets.

c) Rate of nominal annual return to farm assets for the owner is calculated by adding interest on debt to gross farm income and then subtracting returns for labor and management. The resulting term is then divided by the beginning of the year value of total farm assets.

d) Rate of real annual return to farm assets is calculated by adjusting nominal annual returns to farm assets by the CPI.

Table 4.2 continued.

ALBERTA:

YEAR	RETURNS TO FARM ASSETS: NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	NOMINAL ANNUAL RETURN[c]	REAL ANNUAL RETURN[d]	IMPUTED NOMINAL RETURN[e]	IMPUTED RATE OF REAL RETURN[f]	RETURNS TO FARM REAL ESTATE: NOMINAL CAPITAL GAIN[g] C	REAL CAPITAL GAIN[h]	ANNUAL RETURN: IMPUTED RENT[i]	REAL ANNUAL RETURN: IMPUTED RENT[j]	IMPUTED NOMINAL ECONOMIC RETURN[k]	IMPUTED REAL ECONOMIC RETURN[l]
1970	-0.036	-0.049	0.039	0.038	0.003	-0.011	-0.009	-0.023	0.022	0.022	0.014	-0.001
1971	-0.033	-0.074	0.039	0.037	0.006	-0.037	-0.001	-0.047	0.025	0.024	0.024	-0.025
1972	0.120	0.071	0.053	0.051	0.173	0.122	0.174	0.117	0.027	0.026	0.201	0.141
1973	0.180	0.088	0.088	0.080	0.267	0.168	0.250	0.144	0.038	0.035	0.288	0.173
1974	0.218	0.094	0.078	0.089	0.295	0.183	0.346	0.189	0.030	0.027	0.377	0.211
1975	0.147	0.052	0.069	0.063	0.216	0.116	0.284	0.172	0.027	0.025	0.311	0.188
1976	0.134	0.075	0.044	0.042	0.178	0.118	0.186	0.120	0.023	0.022	0.210	0.139
1977	0.143	0.049	0.025	0.022	0.168	0.072	0.178	0.077	0.020	0.019	0.198	0.097
1978	0.156	0.070	0.040	0.037	0.195	0.108	0.193	0.101	0.022	0.020	0.215	0.115
1979	0.329	0.211	0.042	0.039	0.372	0.250	0.417	0.290	0.022	0.020	0.439	0.300
1980	0.211	0.092	0.032	0.029	0.243	0.121	0.282	0.153	0.020	0.018	0.301	0.158
1981	0.077	-0.037	0.032	0.028	0.109	-0.009	0.104	-0.015	0.016	0.015	0.120	-0.013
1982	0.009	-0.076	0.022	0.020	0.031	-0.056	0.010	-0.076	0.018	0.014	0.028	-0.068
1983	-0.044	-0.083	0.014	0.013	-0.030	-0.071	-0.060	-0.101	0.016	0.015	-0.044	-0.087
1984	-0.052	-0.084	0.014	0.013	-0.038	-0.071	-0.070	-0.104	0.017	0.016	-0.053	-0.088
1985	-0.047	-0.083	0.018	0.017	-0.029	-0.066	-0.060	-0.089	0.017	0.016	-0.043	-0.084
1986	-0.050	-0.084	0.039	0.038	-0.011	-0.047	-0.080	-0.117	0.017	0.016	-0.063	-0.102

e) Rate of imputed economic nominal return to farm assets is the sum of the rate of nominal capital gain in farm asset values and the rate of nominal annual return.

f) Rate of imputed economic real return to farm assets is the sum of the rate of real capital gain in farm asset values and the rate of real annual return.

g) Rate of nominal capital gain on farm real estate is calculated by dividing nominal capital gains from farm real estate (the nominal dollar value at the end of the year minus the value at the beginning of the year) by the begining of the year nominal value of farm real estate.

h) Rate of real capital gain on farm real estate is calculated by dividing the real capital gains from farm real estate (the real dollar value at the end of the year minus the value at the beginning of the year) by the beginning of the real dollar value of farm real estate.

i) Rate of nominal annual return to farm real estate is the nominal value rental income divided by the value of farm real estate. Both variables are found in Statistics Canada Cat. No. 21-603E.

j) Rate of real annual return to farm real estate is the value of rental income divided by the value of farm real estate expressed in real dollar terms.

k) Rate of imputed economic nominal return to farm real estate is the sum of the rate of nominal capital gain in farm real estate values and the rate of nominal annual return to farm real estate ownership -- imputed rent.

l) Rate of imputed economic real return to farm real estate is the sum of the rate of real of capital gain in farm real estate values and the rate of real annual

With annual returns of just over 2.0% per year, the debt purchase of farm real estate has not been serviced primarily from current earnings. Reservation prices from real estate are in excess of the average estimate of the imputed rental stream from real estate (Brown and Brown, 1984). The shortfall must be made up by income from elsewhere in the business or from outside the business.

Despite differences in magnitudes, both real and nominal values of farm real estate and farm real estate rental return moved in similar patterns in Canada from 1970 to 1986. Figure 4.7 shows both variables, as a percentage of their respective 1981 values, rising steadily between 1970 and 1980 and declining from 1980 to 1986. During this latter period rental return dropped less rapidly than did real estate values.

4.3.2 Annual Returns to Farm Assets

The annual return to all farm assets is gross farm income minus the returns earned by the operator for labor and management. The remainder after this adjustment is the return earned by capital invested in the farm's assets. Figure 4.7 shows the values of aggregate gross farm income and total farm asset values. As was the case with imputed rental returns and farm real estate, patterns of growth in gross farm income and farm assets were similar during the period 1970 to 1986.

From non-indexed values in Table 4.2 it can be calculated that farm assets in Canada earned an average current (annual) yield of 4.8% in the period 1970-1986, ranging from a high of 8.9% in 1973 to a low of 2.3% in

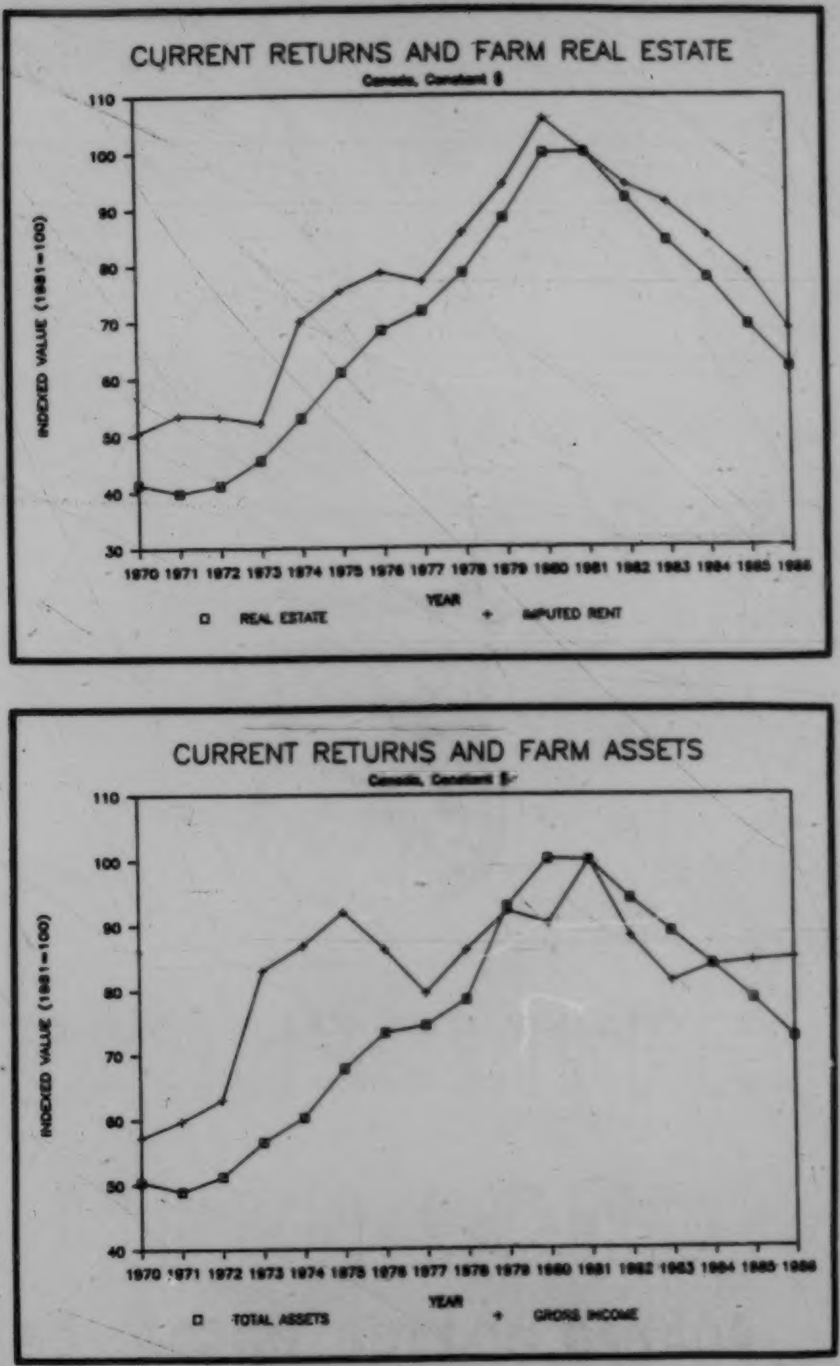


Figure 4.7 Current returns to farm real estate and farm assets, indexed to 1981. Both total farm assets (real estate, machinery, livestock and liquid assets) and farm real estate (land and buildings) have trends similiar to their respective current returns between 1970 and 1986. Values of the variables are listed in Appendix Table A3.1.

1983. The annual returns in Alberta were slightly less, averaging 3.7% over the entire period and ranging from a high of 8.0% in 1973 to a low of 1.3% in 1983 and 1984.

Current returns to farm assets in Canada between 1970 and 1986 were, on average, 2.1 times larger than annual returns to farm real estate. In Alberta, real dollar annual returns to farm assets averaged 1.8 times larger than annual returns to farm real estate. Thus farm assets earned larger average returns than farm real estate due likely to additional returns derived from non-real estate farm assets.

4.3.3 Capital Gains as a Return to Real Estate

Compared to the stable, low positive rates of annual returns discussed in Section 4.4.1, returns in the form of capital gains to farm real estate and farm assets listed in Table 4.2 were volatile, ranging from highly positive to very negative rates for the study period. In fact, real capital gains were only positive in 9 of 17 years during the period.

Figure 4.8 illustrates the rate of real capital gains return to Canadian farm real estate and farm assets between 1970 and 1986. Capital gains in aggregate farm real estate values ranged from a low of -11.3% in 1983 to a high of 19.5% in 1974. This spread of 30.8% in real dollar terms was less than the nominal value high-low spread of 35.2%. Nominal capital gains in Canadian farm real estate values ranged from a low of -3.7% in 1984 to a high of 31.5% in 1974.

Capital gains returns from farm real estate in Alberta were typically more volatile than in Canada for the same period. Real returns to farm real

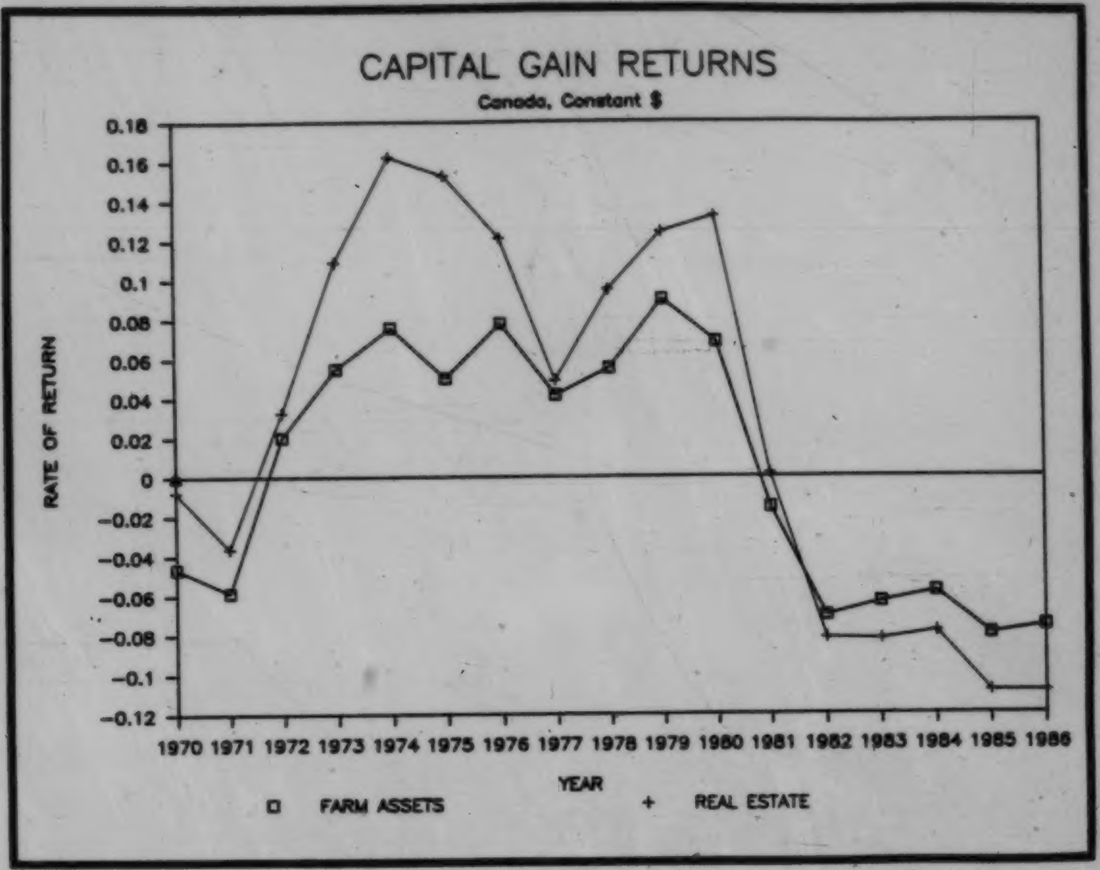


Figure 4.8 Real capital gains returns in values of Canadian farm real estate and farm assets, 1970-1986. Real capital gain in farm assets values is calculated from annual changes in net worth minus net investment. Real capital gain in farm real estate is the annual changes in the value of land and buildings. These aggregate real dollar values are shown to follow similar trends during the period. This is not surprising since farm real estate comprises 64.0% of the total value of farm assets in Canada. Values of these variables are found in Table 4.2.

estate ranged from a low of -13.2% in 1983 to a high of 23.4% in 1974 creating a high-low spread of 35.6% in real dollar terms. In nominal terms, the high-low spread showed that rates of capital gain on farm real estate in Alberta varied by 42.1 percentage points from 1970 to 1986. Nominal returns to farm real estate in Alberta ranged from a low of -6.4% in 1984 to a high of 35.7% in 1974.

These returns tend to follow a consistent pattern which can be observed in Figure 4.8. Real capital losses were experienced in the late 1960's and by 1974 capital gains peaked, but these remained high from 1973 through 1978. Capital losses were again experienced from 1981 through 1984 with the greatest losses occurring during 1983 and 1984. The timing of a farm real estate purchase therefore was vital to the estimation of the profitability of an investment. While investors who purchased and held farm real estate during the early 1970's have experienced capital gains which would have dwarfed returns to capital on the money market, investments made after 1978 have suffered capital losses. The losses incurred through leveraged purchases were even greater than on those from equity purchases. The real value of real estate in 1986 was just slightly higher than its value in 1975, eleven years previously. Even though capital gains in farm real estate have been a volatile form of return, people have continued to forego the higher average and more stable money market returns to invest in farm real estate. Apparently there are perceived current and potential economic and noneconomic benefits which farm real estate returns.

4.3.4 Capital Gains as a Return to Farm Assets

Capital gains on farm assets were of less magnitude and were less volatile than were capital gains to farm real estate over the study period. This trend can be observed in Figure 4.8. In Canada, farm assets yielded annual nominal capital gains returns ranging from a low of -3.3% in 1970 to a high of 19.1% in 1974. Compared to this, real returns went from a low of -9.5% in 1983 to a high of 9.6% in 1974 (see Table 4.2).

Annual returns in Alberta were more volatile than in Canada. Nominal returns had a low of -5.1% in 1984 and a high of 32.9% in 1979. In real terms, the returns ranged from -11.4% in 1983 to a high of 21.6% in 1979.

4.3.5 Total Imputed Economic Return to Real Estate Investment

The total returns expected from investment in farm real estate are viewed here as the sum of annual imputed rental income and capital gains returns. This view of total return is highly controversial since technically these two incomes are not additive and the capital gains returns are not realized annually. However, annual capital gains have sufficient impact on the farm business, farmer well-being and on investment expectations to be included as part of an economic return. Increasing capital gains increases a farmer's borrowing power since the total value of his assets rises. Tests of his financial position, profitability and solvency, show increases when asset values rise. On the other hand, capital losses decrease borrowing power and business solvency. These issues will be discussed further in Chapter 5 It is important to note, however, that neither capital gains nor total expected returns can be used to represent the realized return.

Table 4.2 reports nominal (imputed) economic returns to farm real estate in Canada per year have averaged 11.3% between 1970 and 1986 and ranged from a low of -6.5% in 1986 to a high of 31.5% in 1974. In Alberta, nominal returns were similar, averaging 14.8%. from 1970 to 1986. Annual nominal returns for Alberta ranged from a low of -6.3% in 1986 to a high of 37.7% in 1974.

Also reported in Table 4.2, the real value of imputed economic returns to farm real estate averaged less than nominal dollar returns. In Canada, the nominal return to farm real averaged 3.5%. The range varied from 17.1 in 1974 to -10.2% in 1985 and 1986. In Alberta, the average real value of returns to farm real estate was 6.2%, double the rate of return for all of Canada. From 1970 to 1986 the returns in Alberta were more variable then in Canada, ranging from 30.0% in 1979 to -10.2% in 1986. The 1986 returns represented a plunge in real returns of 40.0% in just 7 years. Real dollar returns to farm real estate were positive for 10 out of 17 years in Canada and they were positive for 9 out of 17 years in Alberta.

The trends in the rates of imputed economic returns to farm assets appear to be very similar to trends in farm real estate. Table 4.2 shows that average annual economic rates of return to farm assets were 12.4% in Canada and 12.6% in Alberta. In real dollar terms, the expected rates of return to farm assets averaged 5.2% in Canada and 5.1% in Alberta. During the period 1970 to 1986, the average returns for Canada and Alberta are remarkably similar. Typically, however, the imputed economic rates of return to farm assets in Alberta were more volatile.

Estimation of an imputed economic return, similar to an annualized income stream, assumes that the investor behaves, at least in the long run as if he accrued annual returns in the form of both income and capital gains. If this assumption can be made, then economic returns will primarily reflect the volatility and magnitude of changes in capital gains.

5. VARIABILITY ANALYSIS AND DISCUSSION

An investor is interested in both the rate and magnitude of the returns to a potential investment; he is also concerned with the reliability of those returns. Annual or periodic variations in capital gains pose a risk to the investor if these factors have not anticipated. In addition, these variations in price will expose an investor's business to some risk if a large share of capital is committed to a single growth asset such as land.

Individuals have preferences for different levels of risk. However, for the purposes of this study, it is assumed that for any given return, less risk is preferred to more. A price risk analysis was performed on Canadian and Alberta annual aggregate farm real estate values using the accepted statistical measures of standard deviation, variance and coefficients of variation in order to approximate the historical risk connected to owning farm real estate. The impacts of variations in farm real estate values on the financial position of the farm business were analyzed using financial ratios. An attempt was made to detect general trends in business performance and business risk which might be linked to changes in farm real estate values.

Capital returns and losses in farm real estate were larger, that is, more volatile, than were returns from either the money market or annual and capital gains returns to total farm production assets. This volatility can be clearly seen in Figure 5.1 where these returns are all shown together. In average terms, capital gains from aggregate farm real estate in Canada for the period from 1970 to 1986 averaged 2.8%. By subtracting only two

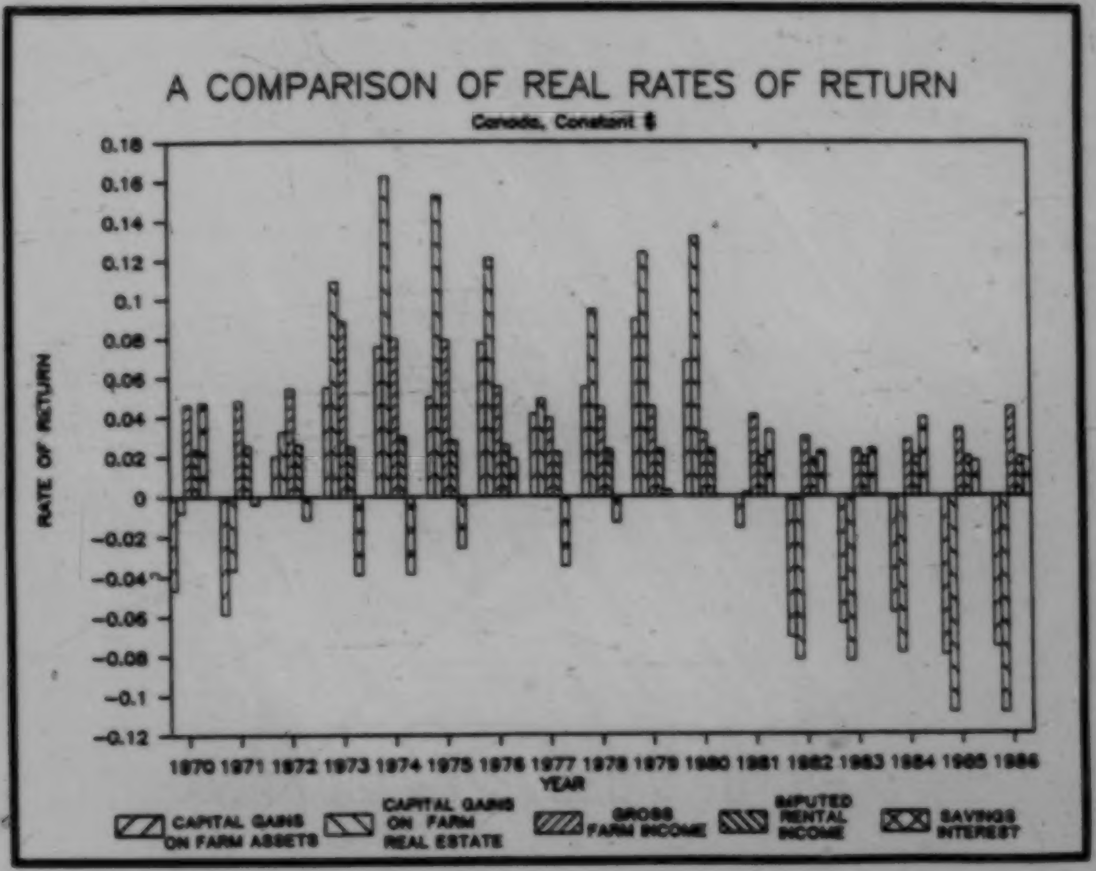


Figure 5.1 A comparison of real aggregate returns to Canadian farm sector investment, 1970-1986. The five rates shown are: capital gains on farm assets, capital gains on farm real estate, annual gross farm income, annual imputed rental income and the typical interest rate on non-chequing savings deposits. Wide variations in the rates of return are seen. Values of capital gains to farm assets and farm estate and annual returns in the form of gross farm income and imputed rental income are given in Table 4.2. The value of real savings interest is given in Appendix Table A1.1.

years, 1985 and 1986, the average capital gains in Canada for the period 1970 to 1984 would have been 4.6% For Alberta the average return for the 1970 to 1986 period was 4.7%. The average rate of return on capital gain in farm real estate would have been 6.7%.

By comparison to capital gain returns in farm real estate, the real dollar average interest rate return in the money market was only 0.3% over the seventeen year period from 1970 to 1986. However, relying on an average expression of capital gains returns or total imputed economic returns belies both the potential for profit from high rates of capital gain and the risk inherent in experiencing high capital losses. During 9 out of 17 years in the study period, annual returns in capital gains exceeded the returns provided by the money market, but during 8 out of 17 years, these returns were less.

5.1 PRICE (MARKET) RISK

The variability or unpredictability of annual farm real estate prices causing variability in returns to farm real estate was measured using standard statistical determinants of variance. In addition, the price risk associated with owning farm real estate as part of a simple farm investment portfolio was also analyzed. Because the standard deviation and variance of aggregate farm data are such large values (often in the millions or billions of dollars), it is helpful to evaluate these values as the ratios of their standard deviations to their means, that is, in terms of a coefficient of variation.

5.1.1 Single Asset Risk: Risk Related to Variations in Return

The coefficient of variation indicates the percentage by which the standard deviation differs from the mean. It is, therefore, a useful indicator of the risk of price and return variations. A high coefficient of variation indicates that the standard deviation is high compared to the sample mean, suggesting a large amount of variability and implying a risky investment. A low coefficient of variation suggests that there is relatively little variation in the variable in question around its mean, and thus implies that the risk of price or return variations in the asset will be low.

The risk of variation in annual returns to farm real estate (imputed rent) in Canada between 1970 and 1986 was relatively low. The coefficient of variation reported in Table 5.1 was .141 (or 14.1%). However, while the risk of variation in annual returns was low, so was the magnitude of the return. Rental income from farm real estate returned an average of only 2.3% to farm real estate values in Canada over the seventeen years of the study. In contrast, while average capital gains returns averaged 5.2%, they varied much more in value. This is evident from the standard deviation of real capital gains which varied from the mean value by 791% -- an increase in the risk of variation in return by 56 times that observed in the annual return.

The risk of variation in real dollar gross farm income was even lower than the variation in annual return to farm real estate. The former variable had a coefficient of variation of 8.1% about an average return of 4.8% versus a 14.1% variation from the mean of 2.3% in the annual return to farm real estate.

RISK ANALYSIS:	AVERAGE	VARIANCE	STTD	COEF. OF VARIATION
1.AS RELATED TO FUNCTIONAL FORM ASSUMED				
REAL PRICE RISK: NO GROWTH[a]	68523051	390877057709147	19770811	0.291
REAL PRICE RISK: CONSTANT GROWTH[b]		3295221010031989	57404016	0.181
2.RETURN RISK: SINGLE ASSETS				
RENTAL INCOME	481813	12532834225	111950	0.141
NOMINAL CAPITAL GAINS ON REAL ESTATE	3942729	49515868609148	7036751	1.779
REAL CAPITAL GAINS ON REAL ESTATE	1158707	43326852988006	6582314	7.912
RENT AND REAL CAPITAL GAIN	1829831	43190817812578	6571972	2.009
GROSS FARM INCOME	15291012	2273808	2273308	0.081
GROSS INCOME + REAL CAPITAL GAIN ON ASSETS	13820133	5862310567742	2421324	0.117
MONEY MARKET (REAL INTEREST RATE)	0.008	0.001	0.028	0.080
(NOMINAL INTEREST RATE)	0.077	0.001	0.028	0.105
3.RETURN RISK: 2 ASSET PORTFOLIO				
ONLY ANNUAL RETURNS	5834121	1.00E+11	316433	0.072
ANNUAL AND CAPITAL GAIN RETURNS	1194744	2.00E+13	4475116	1.977

Table 5.1 Risk analysis of owning farm real estate. The variations in both price (value) of real estate and the returns accruing from land ownership were analysed for aggregate Canadian values over the period 1970 to 1986 using the statistical measures of average, variance, standard deviation and coefficient of variation. All four measures are detailed in Appendix 5; the former three measures are reported in ('000) dollars.

a) Real dollar price variation about the mean.

b) Real dollar price variation about the linear trend.

The extent of variation in the money market appears to be of similar magnitude to variations in annual return to aggregate farm real estate and farm assets as a whole. The coefficient of variation for the Canadian chartered bank's non-chequing nominal interest rate was 10.5%, and this return exhibited an average yield of 7.7% per year. However, when expressed in real dollar terms the standard deviation in the money market is only 3.0% of its mean yield of 0.3% per year from 1970 to 1986.

5.1.2 Risk Related to Price of Farm Real Estate

Variations in returns to farm real estate are directly related to farm real estate values which were in a state of flux from 1970 to 1986. Real estate values varied by 29.1% (see Table 5.1) of their mean values during the period of study. Choice of the arithmetic mean for this calculation, however, implies that the functional form of change over time in real estate values is constant and without growth. In a situation with high constant growth, a large degree of risk could be calculated based on a high degree of variation from the mean. In many cases an investor is interested in quantifying the amount of risk associated with realizing a particular pattern of returns. Usually this could be depicted as a linear growth pattern. As was shown in Section 4.1.3, however, even a linear model poorly describes the trend in land values between 1970 and 1986, and a no growth model is inaccurate. However, if one assumes a linear relationship in farm real estate values and a constant growth in values, the variation of standard deviation of the actual annual data time path and the predicted linear form (not the average form) is 16.1% -- down from 29.1%. It is therefore apparent that prediction of farm real estate values at the level of even a first level polynomial would decrease the perception of the price risk faced by an investor. In so doing a coefficient of variation of 16.1% is calculated for Canadian real estate.

5.1.3 Real Estate in the Farm Portfolio

There are two main strategies for managing price risk in real estate values. The first involves including in the initial assessment of the purchase value (present value) a risk adjusted discount rate and thus discounting future values at a higher rate than would be the case with a non-risk discount rate. However, more important to an investor than changes in real estate values themselves are the actual returns that might be expected. To manage risk in returns from investment in farm real estate, a good strategy is to diversify price risk by including farm real estate as part of a portfolio of invested capital.

In this section of the analysis, farm real estate was assumed to be part of a two asset portfolio. Such a portfolio, comprised of farm real estate and of non-real estate farm assets (including: livestock, machinery, crop and cash inventories, as well as other assets), was intended to simulate a typical farm holdings. The farm real estate portion was assumed to be the actual average of 64% of the aggregate Canadian farm asset portfolio, with non-real estate assets comprising the rest.

When considering only annual returns, the coefficient of variation for the Canadian farm portfolio was found to be 7.2%. Outside the farm portfolio the two components of annual return had higher variances: rent, which comprised 64% of the returns had a coefficient of variation of 14.1%, and gross farm income, which comprised 36% of the returns had variation from its mean of 8.1%.

The variation in annual returns from this typical farm portfolio depend on whether or not capital gain from appreciating values of farm real estate and other farm assets is included as a return along with annual income. Examining only annual returns provides a limited perspective on the risk faced by an investor holding farm real estate. When returns from both annual and capital gains sources were included, the coefficient of variation for the same portfolio was 198%. Although this increase in the variability of returns about a mean return value is startling, it must be kept in mind that the magnitude of the returns which include capital gains also changes. On average the return doubles. However, averaging tends to leave little impression of the highs and lows of capital gains and capital losses experienced during the seventeen years of the study (shown in Table 4.2 and discussed in Section 4.3).

If the variation in overall returns to farm real estate inside the portfolio were considered relative to the returns which might have been expected outside the farm assert portfolio little difference would be observed. The coefficient of variation for farm real estate outside the farm portfolio including both current and capital gains returns was 201%. This is compared to a coefficient of variation of 198% inside the farm portfolio. Therefore, whether inside or outside a farm portfolio, investment in farm real estate leaves the investor vulnerable to liquidity risk in the face of large price changes in real estate and low gross incomes. Other authors have observed that liquidity risk may render remedial business adjustments unfeasible (Featherstone and Baker, 1987, p.544).

5.2 BUSINESS RISK

Business risk defines the exogenous risk to the firm after enterprise choices, production choices and capital structure of the firm have been set in place (Collins, 1985). For example, the price variations experienced in the farm land market present a business risk to those owning or holding farm real estate. Analysis of business performance ratios was undertaken to assess the potential impacts of annual price variations on the financial performance of the farm business. Within the limitations of aggregate financial data, trends and average benchmark values were delineated.

Measures of the financial fitness of the farm business, solvency, capital efficiency, liquidity and profitability, are typically drawn from the balance sheet, income statement, and cash flow statement. Data to complete the former two statements were available from the Statistics Canada data base, (and listed in Tables A1.1 and A1.2), however there was no information on current assets or current liabilities. Liquidity ratios from the latter statement therefore could not be determined. Table 5.2 reports solvency, efficiency and profitability measures of financial fitness for Canada and Alberta aggregate farms from 1970 to 1986.

Usually, as was the case in the results of this study, values expressed in nominal and real dollar terms are considerably different from each other in value. However when ratios such as the business ratios are calculated between values during the same year, nominal and real dollars have no influence on the resulting rate.

Table 5.2 Financial ratios for the hypothetical aggregate Canadian and Alberta farm reported over the period 1970 to 1986. Dollar terms, real or nominal, have no differentiating impact on the financial ratios.

CANADA:

	SOLVENCY RATIOS:[1]			EFFICIENCY RATIOS:[2]	
YEAR	1.CAPITAL RATIO[a] A/L	2.EQUITY RATIO[b] E/A	3.LEVERAGE RATIO[c] L/E	1.TURNOVER[a] A/GI	2.SCALE[b] GI/A
1969	6.39	0.843	0.186	6.03	0.166
1970	6.69	0.851	0.176	6.51	0.154
1971	6.43	0.844	0.184	6.05	0.165
1972	6.69	0.851	0.176	6.00	0.167
1973	7.01	0.857	0.166	5.02	0.199
1974	7.15	0.860	0.163	5.12	0.195
1975	7.34	0.864	0.158	5.44	0.184
1976	7.27	0.862	0.159	6.27	0.159
1977	7.10	0.859	0.164	6.91	0.145
1978	6.98	0.856	0.168	6.72	0.149
1979	7.67	0.870	0.150	7.44	0.134
1980	8.21	0.878	0.139	8.20	0.122
1981	8.04	0.876	0.142	7.38	0.135
1982	7.56	0.868	0.152	7.87	0.127
1983	6.97	0.857	0.167	8.09	0.124
1984	6.72	0.851	0.175	7.40	0.135
1985	6.40	0.844	0.185	6.87	0.146
1986	5.99	0.833	0.200	6.30	0.159

PROFITABILITY RATIOS:[3]

YEAR	1.PROFIT FOR BUSINESS[a] (ROA) (NFI+INT-ROI-ROM)/A	2.PROFIT FOR OWNER/OPERATOR[b] (ROE)(1) NFI/E	3.PROFIT FOR OWNER[c] (ROE)(2) (NFI-ROI-ROM)/E	4.BANK RATE: NOMINAL INTEREST ON SAVINGS[d]	4.BANK RATE: REAL INTEREST ON SAVINGS[e]	5.PROFIT FOR LENDER[f] (ROL) INT/L
1969	0.056	0.064	0.054	0.060	0.060	0.068
1970	0.046	0.052	0.043	0.062	0.047	0.083
1971	0.050	0.058	0.048	0.045	-0.004	0.058
1972	0.052	0.059	0.049	0.040	-0.011	0.067
1973	0.081	0.098	0.084	0.054	-0.039	0.060
1974	0.075	0.087	0.076	0.085	-0.038	0.072
1975	0.071	0.082	0.071	0.070	-0.025	0.069
1976	0.051	0.057	0.047	0.078	0.019	0.074
1977	0.039	0.042	0.034	0.060	-0.035	0.070
1978	0.043	0.046	0.037	0.071	-0.013	0.077
1979	0.038	0.038	0.030	0.101	0.003	0.094
1980	0.030	0.027	0.020	0.112	0.000	0.101
1981	0.041	0.036	0.028	0.154	0.033	0.134
1982	0.032	0.027	0.019	0.115	0.022	0.113
1983	0.024	0.021	0.014	0.088	0.024	0.088
1984	0.030	0.027	0.019	0.077	0.039	0.091
1985	0.036	0.036	0.027	0.061	0.017	0.083
1986	0.048	0.051	0.042	0.060	0.018	0.080

1. Solvency.

   a. Capital ratio = assets/ debt. This measures the amount of assets availible to cover total debts.

   b. Leverage ratio = debt/ equity. This measures the proportion of ownership controlled by the owner and lender.

   c. Equity ratio = equity/ assets. The equity ratio measures the proportion of assets owned by the owner.

2. Capital efficiency.

   a. Turnover = assets/ Gross Farm Income (GFI). This is the number of years needed to turnover the price of assets one time with income produced on the farm.

   b. Scale = GFI/ assets. The amount of money earned per dollar of assets.

3. Profitability.

   a. Return on assets (ROA) = Net Farm Income (NFI)/ assets. ROA measures the net earnings of both owner and lender in relation to the total capital invested in the business.

   b. Return on equity (ROE) = NFI + interest / assets. This is an earnings measurement of the return to owner/ operator.

   c. An alternate form of ROE is expressed as ROA $\doteq$ NFI + interest $-Ro_l - Ro_m$ /assets. The latter form measures the return to owner.

   d. Bank rate: Nominal. The typical current dollar interest rate on non-chequing savings deposits posted in the 5 largest Canadian chartered banks. A more detailed description of this variable is given in Appendix 1.3.

   e. Bank rate: Real. The rate of interest on non-chequing savings deposites expressed in real dollar terms.

   f. Return to lender (ROL) = Interest paid on debt/ liabilities. This measures the profits made by the lenders on business loans.

Table 5.2 continued.

ALBERTA:

YEAR	SOLVENCY RATIOS:[1] 1. CAPITAL RATIO[a] A/L	2. EQUITY RATIO[b] E/A	3. LEVERAGE RATIO[c] L/E	EFFICIENCY RATIOS:[2] 1. TURNOVER[a] A/GI	2. SCALE[b] GI/A
1969	7.17	0.861	0.162	7.45	0.134
1970	7.55	0.868	0.153	7.95	0.126
1971	6.71	0.851	0.175	7.58	0.132
1972	6.90	0.855	0.170	7.17	0.139
1973	6.93	0.856	0.168	6.08	0.164
1974	7.17	0.861	0.162	6.28	0.159
1975	7.63	0.869	0.151	6.67	0.150
1976	7.67	0.870	0.150	7.72	0.129
1977	7.85	0.873	0.146	9.17	0.109
1978	7.87	0.873	0.146	8.48	0.118
1979	9.50	0.895	0.118	9.90	0.101
1980	10.38	0.904	0.107	10.68	0.094
1981	9.54	0.895	0.117	9.68	0.103
1982	8.91	0.888	0.128	10.74	0.093
1983	8.00	0.875	0.143	11.17	0.090
1984	7.38	0.864	0.157	10.22	0.098
1985	6.92	0.856	0.169	9.57	0.105
1986	6.62	0.849	0.178	8.19	0.122

PROFITIBILITY RATIOS:[3]

YEAR	1.PROFIT FOR BUSINESS[a] (ROA) (NFI+INT-RDI-ROM)/A	2.PROFIT FOR OWNER/OPERATOR[b] (ROE) NFI/E	3.PROFIT FOR OWNER[c] (ROE) (NFI-RDI-ROM)/E	4.BANK RATE: NOMINAL INTEREST ON SAVINGS[d]	4.BANK RATE: REAL INTEREST ON SAVINGS[e]	5.PROFIT FOR LENDER[f] (ROL) INT/L
1969	0.045	0.049	0.040	0.080	0.080	0.074
1970	0.039	0.041	0.033	0.082	0.047	0.072
1971	0.038	0.042	0.030	0.045	-0.004	0.062
1972	0.047	0.052	0.043	0.040	-0.011	0.067
1973	0.070	0.082	0.072	0.054	-0.039	0.058
1974	0.063	0.071	0.061	0.085	-0.038	0.076
1975	0.057	0.064	0.054	0.070	-0.025	0.073
1976	0.036	0.040	0.032	0.078	0.019	0.079
1977	0.022	0.021	0.014	0.080	-0.035	0.074
1978	0.034	0.035	0.027	0.071	-0.013	0.080
1979	0.030	0.028	0.022	0.101	0.003	0.100
1980	0.026	0.023	0.018	0.112	0.000	0.106
1981	0.029	0.023	0.017	0.154	0.033	0.134
1982	0.021	0.015	0.010	0.115	0.022	0.112
1983	0.014	0.010	0.005	0.099	0.024	0.079
1984	0.014	0.009	0.003	0.077	0.009	0.067
1985	0.016	0.015	0.008	0.081	0.017	0.080
1986	0.040	0.041	0.034	0.080	0.018	0.076

5.2.1 Solvency

In general, solvency indicates the ability of a business to meet its long-term financial obligations. Three ratios drawn from the balance sheet are used to measure solvency: the capital ratio, the leverage ratio and the equity ratio.

The capital ratio, a ratio of assets to liabilities, shows the financial position of a business assuming that all assets were to be liquidated to cover liabilities. Table 5.2 shows that, in aggregate, Canadian farmers had a maximum of $8.21 worth of assets to cover each dollar of debt at the peak levels of solvency in 1980, while in Alberta farmers had $10.39. During the period 1970 to 1986 the minimum amount of aggregate assets per dollar of debt in 1986 was $5.99 in Canada and $6.62 in Alberta.

The leverage ratio shows the proportion of a business's capital provided by the owner versus the obligation to creditors due if business debts were to be immediately liquidated. Over the 17 year period from 1970 to 1986, both Canadian and Alberta farmers have, in aggregate, maintained a very modest leverage ratio. Table 5.2 shows that on average, this has been 16.6% for Canadian farmers and 14.9% for Alberta farmers. That is, the aggregate debt of the Alberta farm sector was, on average, one seventh of the value of aggregate farm equity. The Canadian aggregate farm sector has, in aggregate, an average $1.00 of debt for every $6.02 of equity.

As may be seen in Table 5.2, the aggregate Canada and Alberta farm sectors were more highly leveraged in 1971 than in any subsequent year. This marked decline corresponds to the general upward trend in land values observed from 1970 to 1986. Thus, contrary to popular thinking, while in aggregate, Canadian farmers have taken on more debt, this debt is covered by more assets than in the early 1970's.

The increasing trend in overall farm debt since the early 1970's occurred in a period when there was a similar proportional rise in the estimate of current market values of on farm machinery stocks. Before 1973 farm machinery was only 55% of its 1981 value, while aggregate farm debt was around 65% of its 1981 value. Both machinery values and farm debt moved upward sharply throughout the mid and late 1970's, peaking in 1981, when the value of machinery began to decline, while the value of debt remained approximately constant (see Table A3.1). The proportional change in debt and machinery value on farms is remarkably similar, suggesting that much of the new debt assumed after the "grain heist" of the early 1970's was invested into machinery purchases and that the buying of new equipment ended abruptly in the early 1980's.

The equity ratio shows the proportion of every dollar of asset that is owner equity. Lee et al. (1980) state that equity ratios under 40% to 50% are often carefully watched by lenders. Of little concern would be an aggregate farmer who owns a large proportion of his assets. In Canada an average of 85.8% of aggregate farm assets are owner equity; in Alberta this ratio averages 87.1%. As the other solvency ratios have shown, a hypothetical aggregate farmer is in a very strong financial position and has considerable capacity to increase debt load.

In calculating these ratios, it was found that:

1) From the aggregate balance sheet, it appears, at least in the aggregate, that Canadian farmers, including those in Alberta, are

solidly solvent. They are modestly leveraged and tend to own most of their assets.

2) During the period of rising land prices in the 1970's, solvency measures for the Canadian and Alberta aggregate farm sector remained remarkably stable.

3) As asset values rose, so did the aggregate debt capacity and actual value of liabilities. However the ratio of assets to liabilities and equity to liabilities fell over the period from 1970 to 1986.

4) In aggregate, Alberta farmers have been more conservative than their national counterparts in maintaining a solvent business.

5.2.1.1 Owning a Growth Stock: The Impact on Solvency

A business's ability to cover its long term debts with capital improves as farm real estate values rise. In addition, the greater the proportion of positively growing stock in the farm portfolio, the stronger is the business's capital position. However, during times of depreciating real estate values, the business will experience lowered levels of solvency as the margin of capital covering debts decreases. This is especially so if the business was highly levered.

Borrowing potential rises and falls with real estate values. It is also sensitive to the proportion of the farm investment portfolio held in farm real estate. Investing in a farm portfolio in which a large portion of capital is in farm real estate has been a risky but very easy way to build equity. The experience of the 7 years from 1970, suggests that simply holding the positively growing stock will increase equity and overall growth can be maintained without increasing production or product marketing. The risks to the business are that if growth in farm real estate becomes negative, equity will be eroded even though the business is maintained as before.

5.2.2 Efficiency

Ratios showing trends in income to investment are taken from the income statement and balance sheet in order to monitor the financial efficiency of the farm business and to detect the efficiency and effectiveness with which the capital of a business is being put to use to generate gross income. Two financial ratios are commonly used to measure financial efficiency. These are turnover and scale.

Turnover, the ratio of the value of total farm assets to gross farm income, is a measure of how quickly capital is regenerated by gross income. As shown in Table 5.2, the real capital turnover time in Canada ranged from 6.0 years in 1973 to 11.2 years in 1983. The turnover time in Canada averaged 6.7 years The increase in the years needed to turnover farm capital suggests that capital became less efficiently used since it would have taken twice as long for gross income to accumulate in 1983 than in 1973. It would have taken Alberta farmers one year more to turnover the total farm capital values in 1973 and 4 years longer in 1983 than for Canadian farmers as a whole. Alberta farmers must therefore face making less efficient use of their capital than Canadian farmers.

Financial scale compares the size of the business when measured by gross income to its size when measured by asset values. Mathematically, scale is the inverse of turnover. It measures the effectiveness of capital for the generation of income. As listed in Table 5.2, Canadian farmers, in aggregate, had an average $1.00 of capital for $0.15 they generated in real gross income. In Alberta, farmers generated $0.12 of gross income of every dollar of capital held. As real estate values rose during the period of study, the efficiency of capital in generating income decreased. As real estate values fell in 1985 and 1986, the negative trend in this measure of efficiency appears to have reversed.

From an examination of of the two measures of financial efficiency cited here, the following were noted:

1) The aggregate farm business in Alberta and Canada became less financially efficient between 1973 and 1984. The use of capital was both less efficient and less effective; its ability to service debt on capital was diminished. These trends were primarily due to rising asset values, although fluctuations in gross income contributed to this trend.

2) The number of years required to turn over capital once relative to gross farm income doubled between 1973 and 1983 for both Canadian and Alberta farmers. When turnover is high, capital is only slowly freed for other uses.

3) Such decreases in financial scale suggest that farm gross income became increasingly less effective in paying off asset values as real estate values rise.

4) The margin of gross income which is available for debt servicing and family withdrawal decreased between 1973 and 1986 for both Canadian and

Alberta farmers.

5.2.2.1 Owning a Growth Stock: The Impact on Financial Efficiency

A farm investment portfolio in which a large portion of the capital is is invested in a growth stock such as farm real estate has a negative impact on the financial efficiency of the farm's business. In addition, the larger the proportion of the growth stock in the portfolio mixture, the more limited its income generating capacity. Thus, when a farmer is assembling an asset portfolio, the choice of both the type of capital invested in, whether growth or nongrowth, and the proportion of each type in the portfolio are decisions which affect the ability to generate income.

5.2.3 Profitability

Rate of return on assets, rate of return on equity and rate of return to lender are ratios which measure income profitability relative to investment. Capital gains contribute a considerable return to investment for owning or holding farm land. However, since returns from capital gains are not realized annually, they are not considered an income return and are not included as a measure of business profitability. Table 5.2 lists all three of these ratios in real dollar values for both Canada and Alberta.

Simple calculations of returns to assets (ROA) and returns to equity (ROE) can be adjusted to more accurately reflect uncommitted profits by subtracting returns to family labor and return to management from net farm income. Using an unadjusted evaluation of net farm income to calculate ROA and ROE will provide underestimates of ROA or ROE. Figure 5.2 shows only

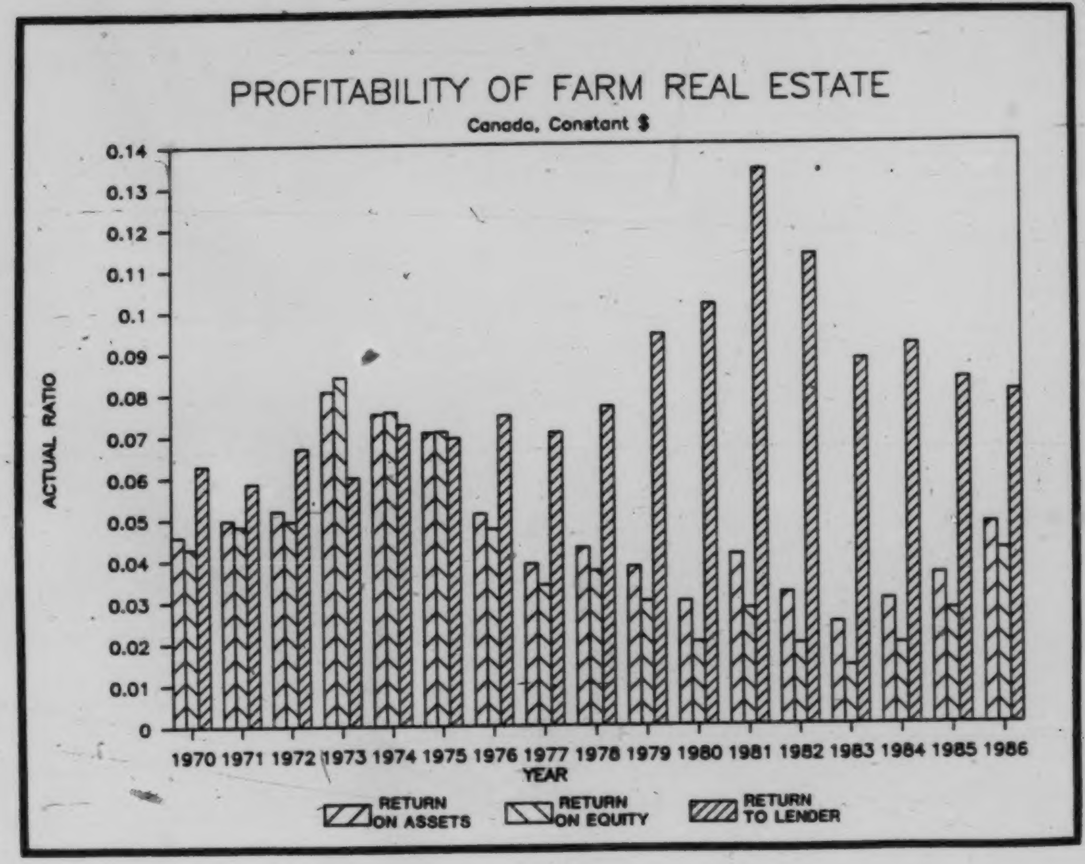


Figure 5.2 Profitability in the Canadian farm real estate market, 1970-1986. A comparison of return on assets (ROA), return on equity (ROE) and returns to the lender (ROL) are shown. While all three returns were similar in the early 1970's, since that time ROA and ROE have declined appreciably, returns to the lender have risen, resulting in a large discrepancy in the rates of return. The rates of return are listed in Table 5.2.

adjusted measures for ROA and ROE.

Return on assets (ROA) measures the net earnings of both owner and lender in relation to the total capital invested in the business. ROA is sensitive to changes in gross income, farm expenses, the amount of interest paid to creditors and to changes in asset values. This concept is identical to the annual returns to farm assets, discussed in section 4.3.2. Annual (adjusted) estimates of ROA, shown in Figure 5.2, increased during the period from 1970 to 1973 and have been declining since that time. The lowest returns to assets were in 1983 when Canadian farm assets returned 2.4% expressed as an aggregate annual rate of real dollar annual return and Alberta farm assets generated a 1.4% annual rate of annual return.

The return on equity (ROE) ratio shown in Figure 5.2 measures the profit accruing to an asset owner or owner/operator relative to the equity held in the asset. Annual return on equity held by an owner/operator, expressed in real terms, peaked in 1973 at a rate of 9.6% in Canada and 8.2% in Alberta.

By 1984 annual return to owner equity in farm assets, expressed in real values, was a mere 0.3% in Alberta; in Canada, by 1984, this return was only 1.9%. Figure 5.3. illustrates real dollar returns to equity in both farm assets and, for comparison, on equity capital held in non-chequing savings deposits. These two measures of returns to equity capital invested in different investments were remarkably similar in 1970 and also in the period from 1981 to 1986. During the period of rapid growth in land values, returns to equity in land were both positive and larger than were corresponding returns on equity capital held in non-chequing savings

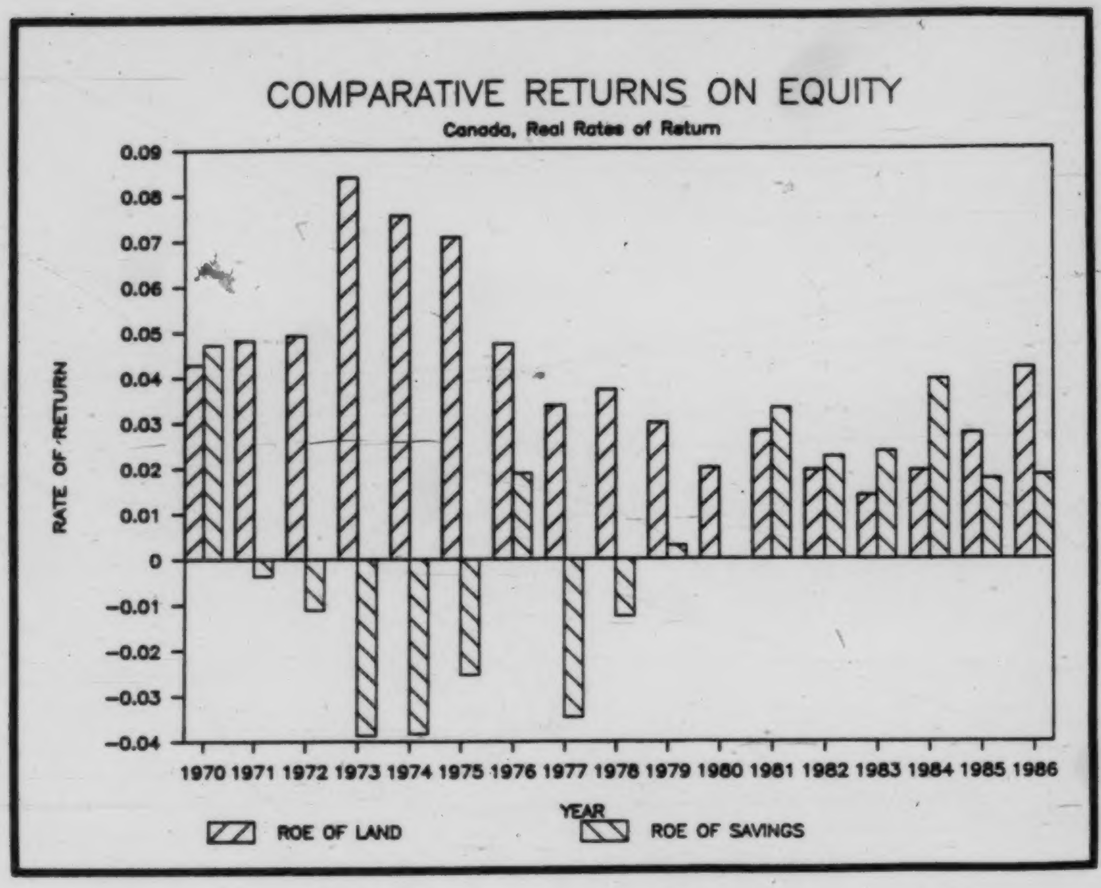


Figure 5.3 Rates of return on equity capital investment, 1970-1986. A comparison is made between equity capital invested in Canadian total farm assets (calculated as net farm income minus returns to labor and management, divided by owner's equity) and typical bank savings deposits. The two investments yielded similar rates of return early in the 1970's and in the early to mid 1980's. However, during the mid 1970's, returns to equity capital in farm assets were much higher than the real dollar yields from savings interest. The individual rates of return are found in Table 5.2 as bank rate: interest on savings and ROE: profit for owner.

deposits in the Canadian chartered banks which were actually negative in real dollar terms.

Return to the lender, expressed as the ratio of interest paid relative to total liabilities, is a measure of the profits made by the creditors of the business for the use of their money. Except for a brief period of time between 1973 and 1975, in both Canada and Alberta creditors earned a higher rate of return than did equity holders of farm assets (see Table 5.2). By 1981, Alberta creditors were earning 11.7% more than were equity holders. In Canada this discrepancy was 10.6%. However, 1981 was an exceptional year in that both interest rates and land values peaked, thus tending to increase lender returns on debt.

In summary, the spreadsheet data presented in both Table 5.2 and Figure 5.2 indicated that for the aggregate farmer:

1) Real annual return to capital invested in farm assets and to equity in farm assets peaked in 1973 and fell steadily after that.

2) Returns on assets and returns on equity are inversely proportional to farm real estate values.

3) Real money market returns to equity exceeded returns to equity in farm assets in Canada for 5 out of 17 years. In nominal dollars the money market returns on equity were larger than for equity held in farm real estate for 12 out of 17 years.

4) Assisted by high interest rates and high land values, nominal returns to lenders rose to a peak of 13.4% in Canada in 1981.

5.2.3.1 Owning a Growth Stock: Business Profitability

The larger the proportion of farm real estate in the farm investment portfolio, the lower the business potential is to earn profits from income generated by portfolio capital (or equity in that capital). As in the case of the efficiency ratios, it is evident that capital invested in farm assets does not efficiently generate either income or profits. However, it is also apparent that agricultural programs or policies should not be based solely on measures of business efficiency and business profitability without taking into account the role of real capital gains. Assessment of business performance needs to be isolated from asset appreciation and depreciation; this could be done by using purchase values for assets rather than current market values when making business performance assessments.

5.3 FINANCIAL RISK

Maintaining high levels of leverage can represent an economically sound attempt to use the opportunity of rising asset values to boost the growth of an investor's farm business. However, it is the responsibility of the investor to assure that liquidity is maintained at a level that allows the cash obligations of the business, portfolio, and family to be simultaneously met. The potential for cash flow deficiencies due to shortfalls in year to year income, changing interest, unexpected business or production loss or family needs exists and, at an extreme, may force the liquidation of assets. To carry high levels of leverage safely requires the maintenance of sound liquidity practices. These may include maintaining credit reserves, generating off farm incomes, using alternate production strategies, and practicing forward marketing or leasing.

There is a balance between maintaining liquidity and foregoing opportunities for growth. Table 5.3 shows aggregate annual price to earnings (P/E) ratios for farm real estate and for farm assets in Canada and Alberta 1970 to 1986. High P/E ratios, between 37 and 51 in Canada, for farm real estate suggest that investors have felt that farm real estate has had good and fairly steady growth opportunities over the period. Investors were willing to bid the price of real estate far above the earnings levels that are recovered.

It appears that these earnings (rent) were perceived to be relatively safe despite being very low (i.e. rent from a property being less than its mortgage payments). This perception is borne out by the data. Aggregate rental income was, on average, 2.3% of the aggregate value of real estate and it averaged 9.0% of gross farm income between 1970 and 1986.

5.3.1 Cash Flow Issues

The liquidity necessary to finance investment in farm real estate is more apparent if farm assets are viewed as a portfolio of farm real estate and other non-real estate farm assets. Non real estate farm assets had P/E's between 5 and 8 at the Canadian aggregate level, or 1/6 to 1/9 the P/E of farm real estate alone (see Table 5.3). Diversification of assets to this relatively limited extent not only helped reduce price risk to the investor (see Section 5.1), it also substantially increased the returns per dollar invested, providing the cash flow necessary to meet the cash obligations of purchasing farm real estate.

CANADA:			ALBERTA:	
YEAR	TOTAL FARM ASSETS/ $ EARNINGS[a]	VALUE OF REAL ESTATE/ $ RENT[b]	TOTAL FARM ASSETS/ $ EARNINGS[a]	VALUE OF REAL ESTATE/ $ RENT[b]
1969	6.03	37.0	7.4	42.1
1970	6.51	41.9	7.9	44.6
1971	6.05	38.1	7.6	40.4
1972	6.00	39.5	7.2	43.1
1973	5.02	44.8	6.1	32.8
1974	5.12	38.7	6.3	44.2
1975	5.44	41.4	6.7	47.8
1976	6.27	44.4	7.7	51.1
1977	6.91	47.6	9.2	58.2
1978	6.72	46.9	8.5	54.7
1979	7.44	47.9	9.9	63.1
1980	8.20	48.3	10.7	65.6
1981	7.38	51.1	9.7	67.6
1982	7.87	49.8	10.7	64.9
1983	8.09	47.3	11.2	58.6
1984	7.40	46.6	10.2	54.8
1985	6.87	45.1	9.6	55.4
1986	6.30	46.1	8.2	54.9

Table 5.3 Price to earnings (P/E) ratios for aggregate Canadian and Alberta values from 1970 to 1986. Dollar terms, nominal or real, have no differentiating impact on price earnings ratios.

a) The P/E for farm assets is calculated by dividing the value of farm assets by the value of gross farm income.

b) The P/E for farm real estate is calculated by dividing the value of farm real estate by the value of imputed rental earnings.

Despite favorable long-term nominal and real rates of return on farmland investment, severe cash-flow difficulties are caused by shifting earnings from cash (income) returns to capital gains. In aggregate, the Canadian and Alberta farm sector has responded by maintaining high levels of solvency. Although it may have been financially possible to use more debt for business advantage, this was not done.

This dilemma permeates the agricultural sector. In early years of investment, a young family aspiring to be full time owner operators are limited by cash flow to the debt which can be serviced. The time needed to turn over assets is of especial concern for entry-level farmers. While low gross incomes, high asset values or a combination of the two will extend turnover time, a farmer's only control of how efficiently capital is used lies in the ability to influence the magnitude and stability of his gross income. An entry level farmer faced with a long period of time before farm capital can be regenerated from farm gross income may perceive this as a future barrier to growth and may choose to invest capital and energies in assets which will generate more income. Ownership of farm real estate or purchase of a business unit may become an unattractive barrier to entry-level farmers disadvantaged by cash flow problems.

Established farmers are generally in a much stronger liquidity position. They are expanding or consolidating farmers who have been able to survive cash flow deficiencies and high fixed costs associated with entry by building a business which generates sufficient cash flow, through careful family consumption, efficient production and marketing of their products and outside incomes. However, since they can service high levels of debt with their cash flow and solvency positions, they may be motivated to do so to take advantage of scale economies. Should land values drop, the consolidating farmer faces risks associated with both low liquidity reserves and a declining solvency position. The comparative advantage in farm real estate investment rests with the farmer, later in years, whose investments finally generate large cash surplus over family living costs. These farmers may, however, again be faced with liquidity problems in their retirement if they decide to refinance the family farm for the next generation. They also face an erosion of wealth if asset values fall or if they do not carefully plan the dissolving of estate with regard to capital gains tax and transfer costs. Lee et al. (1980) quote liquidation costs of 10% to 40% of the original value of assets owned prior to liquidation.

Attempts by governmental agencies to facilitate the entry of young people into agriculture by extending assistance in forms such as inexpensive loans are often criticized because "such terms benefit only earliest buyers. Cash flow and equity advantages are soon bid into the price of land. With each relaxation of credit terms, land prices can be expected to rise more rapidly, then assume a normal pattern" (Reinsel and Reinsel, 1979, p. 1096).

Other attempts to treat the cash flow deficiencies of leveraged farmers in periods of declining annual returns and asset values may lead to government-prescribed systems of output payments or price supports. This strategy is also criticized because it would not only "fail to raise rates of return after land prices adjust but would actually intensify the cash flow problem for entry level farmers. The real problem, one of liquidity, would be worsened because cash outflow to service land land interest, and principal payments would increase relative to cash outflow for new owner operators" (Tweeten, 1981, p. 23).

However at the current time, individuals within the Canadian and Alberta agricultural sectors are making adjustments to carry out viable forms of agriculture undaunted by the many barriers and aided by government programs. Investors interested in agriculture but not willing to risk a cash flow "crunch" are finding other ways to enter and stay in farming. Assistance from family plays an important role enabling many individuals to farm. To decrease the impact of cash flow restrictions, individuals are using different strategies. They may farm part time and work off the farm for wages or they may form corporations with access to both debt and equity capital. Some forms of corporations may be able to stop the losses of capital from agriculture which occurs in generation financing and life cycle management and financing of the family farm.

In the end it may be those who adapt and those who find ways of coping with or alleviating their financial problems who will continue in agriculture. It may be the pessimists who sell out their farm businesses to the optimists (Brown and Brown, 1984).

6. CONCLUSIONS

Between 1970 and 1986, Canadian and Alberta farm real estate has been exhibiting the characteristics of a growth stock. The value of farm real estate has changed at a rate different than the rate of general inflation. Land values rose quickly in the 1970's, stabilized in 1980 and 1981, and have been falling since that time. This historical pattern can be described by a cubic polynomial. Overall, the real dollar growth rate has averaged 4.7%, representing an increase of real estate values of nearly 150% between 1970 and 1986. Thus, the rate of growth in farm real estate values has not been constant over the seventeen years examined in this study.

Returns to farm estate have provided economic motives for investors to participate in the land market. Ownership of land has been profitable over the period from 1970 to 1986, earning real returns to equity that averaged 4.0%. This is in contrast to real dollar returns on equity in chartered bank's non-chequing savings accounts of 0.7%. The returns on investment in farm real estate have consisted of both current income (rent), as well as contributions to wealth in the form of capital gains.

As is typical of growth stocks, the annual returns to land have been very low. Rent, the annual return to farm real estate, averaged only 0.7% of farm real estate values, varying in a pattern similar to that of farm real estate values.

On the other hand, real capital gains returns to land have been highly volatile. These ranged from a high of 19.5% in 1974 to a low of -11.3% in

1983 in Canada and were positive for only 9 out of the 17 years. The large gains posted throughout the 1970's are being rapidly eroded by falling land prices in the 1980's.

The repercussions of volatile land prices and returns have been realized in several different types of risk. The unpredictability of prices has posed a risk to holding both a single, farm real estate asset and a representative farm asset portfolio. However, farm land investors may diversify the single asset into a more balanced investment portfolio and dilute some of the effects of extreme variations in the price of land. Uncertainty in the magnitude of income returns to farm land ownership has an impact on the financial position of the farm business. Capital efficiency and income profitability move inversely in proportion to real estate prices, while solvency is proportional. High land values restrict the liquidity of the farm business if debt capital has been used to finance current farm land purchase.

The influences of farm land prices are also likely to be seen in the structure of the agricultural sector. Barriers to entry are posed by high land prices because of increased turnover periods and cash restrictions. High values appear to favor the consolidation of land by established farmers who have the potential cash flow necessary to service debt accumulation, as well as strong solvency positions to support it. Farmers are accumulating wealth by investing in land. This represents a transformation of income into wealth. Despite the real cash flow difficulties that are experienced by farmers, if governments continue to assist farmers in the purchase of land, they should recognize that they are assisting farmers in the accumulation of wealth.

The banner cry raised by Melichar (1979) that agriculture is doomed to low rates of annual return need not be the epitaph of the farm industry. If farmers recognize that although use of their capital to purchase farm real estate guarantees a low annual return, they can control of the proportions of their investment portfolios that are committed to this asset. By varying the composition of this portfolio they can regulate the general levels of income expected. Farmers do not have to face Melichar's sentence helplessly.

This conclusion can be made notwithstanding the problems of either aggregation or data specification encountered in this study. Aggregation of national data into an agricultural balance sheet required some heroic assumptions. Data specification would have been improved if Statistics Canada series were available for the value of improvements in agriculture, the accounting adjustment used by Melichar; the value of current assets on farms in Canada; and if the data available had been more detailed for the value of agricultural rental income. In addition, returns and expenses may have been attributed to the wrong year since there is no one date during the year when a farm financial snapshot of values for all assets and liabilities is reported by Statistics Canada. Unaccountable observational error may have been introduced at any time by after the fact revisions to the data series made by Statistics Canada, by the series being initially collected for divergent purposes, or by demographic changes in the sample population over time.

To further the work presented in this thesis, a comparison of the results reported on American land values by Melichar (1979) and this Canadian study may be of interest. The two studies are designed identically and would thus provide an useful base for the comparison of forces shaping farmland values in Canada and the U.S. as well as making possible an overview of the dynamics of the price behavior of farmland values in North America.

REFERENCES

Alston, J.M. (1986), "An analysis of growth of U.S. farmland prices, 1963-1982": **Amer.J. Ag. Econ.**, v.68, no.1, p.1-9.

Agriculture Canada (1981), **Selected Agricultural Statistics for Canada and Provinces, 1981**, publication 81/2.

Aplin, R.D., G.L. Casler, and C.P. Francis (1977), **Capital Investment Analysis: Using Discounted Cash Flows**: Grid Publishing, Inc., Columbus, Ohio.

Aukes, R.G. (no date), "A partial solution to the current problem in agriculture credit" unpublished working paper.

Aukes, R.G. (1984), **The Financial Crisis in Canadian Agriculture, 1984 Evaluation of Some Proposed Responses**: sponsored by REDA, University of Alberta, Edmonton.

Aukes, R.G. (1985), "An economic/accounting approach to farmer's income and capital": **Research Bulletin 85-2**, Department of Agricultural Economics and Farm Management, University of Manitoba, Winnipeg.

Barry, P.J. (1980), "Capital asset pricing and farm real estate": **Amer. J. Ag. Econ.**, v.62, p.549-553.

Barry, P.J. (1981), "Capital asset pricing and farm real estate: Reply": **Amer. J. Ag. Econ.**, v.63, p.580-581.

Barry, P.J., Hopkin, J.A. and C.B. Baker (1979), **Financial Management in Agriculture**, Interstate Printers and Publishers, Inc., Danville, Illinois.

Bauer, L. (1983), "Farm properties as a capital investment", AIM, v.27, Book 3.

Bauer, L. (1984), "Systematic analysis: Tools for problem definition and opportunity recognition", presented at 9th Agricultural Credit Seminar, Nov./Dec. 1984, Finafrica Foundation, Milan, Italy, p.1-15.

Bhatia, K.B. (1971), "On estimating capital gains in U.S. agriculture",**Amer. J. Ag. Econ.**, v.53, p.502-505.

Boehlje, M.D. and V.R. Eidman (1984), **Farm Management**, John Wiley and Sons, New York.

Boyne, D. (1964),**Changes in Real Wealth Position of Farm Operators, 1940-1960**, Tech. Bull. no. 294, Michigan State University, East Lansing, MI.

Boulding, K.E. (1962), "Economics and accounting: the uncongenial twins", in **Studies in Accounting Theory**; W.T. Baxter and S. Davidson, ed., Richard D. Irwin, Inc., Homeland, IL.

Bradley, M. (1980) **Microeconomics**, Scott, Foresman and Company, New York.

Brake, J.R. (1968), "Firm growth models often neglect important cash withdrawals", **Amer. J. Ag. Econ.**, v.50, p.769-771.

Brake, J.R. and Melichar, E.M. (1977), "Agricultural finance and capital markets", in **A Survey of Agricultural Economics Literature**, vol. 1, L.R. Martin, ed., University of Minnesota Press, Minneapolis, p.411-494.

Brealey, R. and S. Myers (1981), **Principles of Corporate Finance**, McGraw Hill Book Co., New York.

Brigham, E.F. and L.C. Gapenoki (1985), **Intermediate Financial Management**, Dryden Press, Chicago.

Brinkman, G.L. (1980), "Reflections on farm income in the 1970's", **Canad. J. Ag. Econ.**, v.27, p.56-66.

Brinkman, G.L. (1981), **Farm Incomes in Canada**, Economic Council of Canada, Canadian Government Publishing Centre, Ottawa.

Brinkman, G.L. (1983), "Agricultural economists and L-R challenges facing Canadian agriculture", **Canad. J. Ag. Econ.**, v.31, p.3-14.

Brinkman, G.L. and J.H. Clark (1985), "Captialization of agricultural land: Relation of real capital appreciation to rates of return to capital on commercial farms, Canada and provinces, 1971-1982", working paper, School of Ag. Econ. and Extension Education, University of Guelf, Guelf, Ontario (March 1985).

Brown, K.C. and D.J. Brown (1984), "Heterogeneous expectations and farmland prices", **Amer. J. Ag. Econ.**, v.66, p.164-169.

Burt, O.R. (1986), "Econometric modeling of the capitalization formula for farmland prices", **Amer. J. Ag. Econ.**, v.68, p.10-26.

Canada Farm Credit Corporation (1984), **Farm survey**

Carter, C. (1981), "Capital asset pricing and farm real estate: comment", **Amer. J. Ag. Econ.**, v.63, p.578-579.

Castle, E.N. and I. Hoch (1982), "Farm real estate price components, 1920-1978", **Amer. J. Ag. Econ.**, v.64, p.8-18.

Chase, L. (1980), "Inflation, capital gains, and farmers' well-being", **Canad. J. Ag. Econ.**, v.27, p.67-77.

Chase, L. (1980), **Measuring the Economic Well-being of Canadian Farmers, 1949-1976**, unpubl. M.Sc. thesis, Dept. Rural Economy, University of Alberta, Edmonton.

Chase, L. and M.L. Lerohl (1981), "On measuring farmers' economic well-being", **Canad. J. Ag. Econ.**, v.28, p.225-232.

Collins, R.A. (1985), "Expected utility, debt-equity structure and risk balancing", **Amer. J. Ag. Econ.**, v.67, p.627-629.

Dobbins, C.L. and T.G. Baker, L. Dunlap, J.W. Pheasant, B.A. McCarl (1981), **The Return to Land Ownership and Land Values: Is There an Economic Relationship?**, Dept. Ag. Econ., Agricultural Experiment Station Bull., Purdue University, West Lafayette, IN, p.1-31.

Doll, J.P. and F. Orazem (1978), **Production Economics**, John Wiley and Sons, Toronto.

Doll, J.P. and R. Widdows (1981), "Capital gains versus current income in the farming sector: comment", **Amer. J. Ag. Econ.**, v.63, p.730-737.

Drynan, R.G. and I.D. Hodge (1981), "The value of unrealized farm land capital gains: comment", **Amer. J. Ag. Econ.**, v.63, p.281-282.

Farm Credit Corporation (1969-1986), **Farm Credit Statistics**

Featherstone, A.M. and T.G. Baker, (1987), "An examination of farm sector real asset dynamics: 1910-1985", **Amer. J. Ag. Econ.**, v.69, p.532-546.

Feldstein, M. (1982), "Inflation, portfolio choice, and the prices of land and corporate stock", **Amer. J. Ag. Econ.**, v.64, p.910-916.

Fenton, J.K. (1978), "Rural capitalization rates and processes",**Proceed., Farm Management and Agricultural Appraisal, 1978**, July, 1978, Regina, Saskatchewan.

Frey, T.L. and D.A. Klinefelter (1982), **Coordinated Financial Statements for Agriculture**, Agri Finance, Skokie, IL.

Gardner, B.L. and B. Hottel (1980), "The rate of return to investment in agriculture and the measure of net farm income", mimeographed copy of paper presented at Amer. Assoc. Ag. Econ. Selected Papers Presentation, March 7, 1980.

Grove, E.W. (1948), "Measurement of farm income and expenditure", mimeographed copy of paper presented at a meeting of Amer. Stat. Assoc., December 29, 1948, Cleveland, OH.

Grove, E.W. (1960), "Farm capital gains -a supplement to farm income?", **Ag. Econ. Research**, v.XII, no.2, p.37-42.

Harris, D.G. (1977), "Inflation- indexed price supports and land values", **Amer. J. Ag. Econ.**, v.59, p.489-495.

Harris, D.G. (1979), "Farm land, inflation and farm income: discussion", **Amer. J. Ag. Econ.**, v.61, p.1105-1106.

Heady, E.O. and J.L. Dillon (1961), **Agricultural Production Functions**, Iowa State University Press, Ames, IO.

Holbein, M. (1982), **Farm Operating Expenses and Depreciation Charges: Data**

Sources, Concepts and Methods, Methodology Paper no. 4, Ag. Stat. Div., Statistics Canada.

Hoover, D.M. (1962), "The measurement and importance of real capital gains in United States agriculture, 1940 through 1959" **J. Farm Econ.** v.XVIV, no.4, p.929-940.

Huff, H.B. and T.J. Cusack (1972), **Capital Gains in Canadian Agriculture**, University of Guelph Pub. no. AE/72/1.

Hughes, D.W., J.B. Penson and C.R. Bednarz (1984), "Subsidized credit and investment in agriculture: the special case of farm real estate", **Amer. J. Ag. Econ.**, v.66, p.755-760.

Humphrey, F.S. (1980), "U.S. small farm policy scenarios for the eighties", **Amer. J. Ag. Econ.**, v.62, p.879-888.

Kay, R.D. (1981), **Farm Management: Planning, Control and Implementation**, McGraw-Hill Book Co., New York.

Kost, W.E. (1968), "Rates of return for farm real estate and common stock", **Amer. J. Ag. Econ.**, v.49, p.213-224.

Kuttner, R. (1984), **Economic Illusion: False Choices Between Prosperity and Social Justice** Houghton Mifflin, Boston.

Lee, W.F. (1976) "A capital budgeting model for evaluating farm real estate purchases", **Canad. Farm Econ.**, v.11, n.3, p.1-10.

Lee, W.F., N.D. Boehlje, A.G. Nelson and W.G. Murry (1980), **Agricultural Finance**, Iowa State University Press, Ames, IO.

Lerohl, M.L. (1967), **Assets, Liabilities and Net Worth of Canadian Farm Operators, 1935- 1964**, Ag. Research Council Canada, p.1-52.

Lins, D.A. and P.J. Barry (1984), "Agency status for the cooperative farm credit system", **Amer. J. Ag. Econ.**, v.66, p.601-606.

Lins, D.A. and M. Duncan (1980), "Inflation effects on financial performance and structure of the farm sector", **Amer. J. Ag. Econ.**, p.1049-1053.

McConnen, R.J. (1979), "Annotated charts and tables to accompany 'Capital gains versus current income in the farming sector'", presented at joint meeting of Amer. Assoc. Ag. Econ. and Western Ag. Econ. Asoc., Pullman, WA., August, 1, 1979.

McConnen, R.J. (1979), "Capital gains versus current income in the farming sector" **Amer. J. Ag. Econ.**, v.61, p. 1085-1092.

McConnen, R.J. (1979), "Land prices, inflation, and farm income: discussion" **Amer. J. Ag. Econ.**, v.61, p.1103-1104.

Melichar, E. (1981), "Capital gains versus current income in the farming sector: reply", **Amer. J. Ag. Econ.**, v.63, p.734-737.

Melichar, E. (1983), "Farm wealth: origins, impact and implications for public policy", Myers Memorial Lecture, Dept. Ag. Econ., Cornell Univers. Ag. Exper.Station, p.1-33.

Melichar, E. (1984), "A financial perspective on agriculture", **Federal Reserve Bull.**, Board of Governors of the Federal Reserve System, January, 1984.

Melichar, E. (1984), "The incidence of financial stress in agriculture', presented at Agricultural Seminar, Congressional Budget Office, U.S. Congress, November 13, 1984.

Melichar, E. (1986), "The genesis of farm financial difficulties",**Federal Reserve Bulletin**, July 1986, p.440-443.

Melichar, E. (1987), "Agricultural finance: Turning the corner on problem farm debt", presented at the Tenth Annual U.S./U.S.S.R. Economic Symposium, Tbilisi, U.S.S.R., September 1987.

Melichar, E. and S. Marian (1975), "Capital gains in the U.S. farming sector, nominal and real, 1940-1974", presented at annual meeting of Amer. Ag. Econ. Assoc., Columbus, OH., August 11, 1975.

Melichar, E. and S. Marian (1975), "Tables to accompany capital gains in the U.S. farming sector, nominal and real, 1940-1974", presented at annual meeting of Amer. Ag. Econ. Assoc., Columbus, Oh., August 11, 1975.

Penson, J.B. Jr. (1972), "Demand for financial assets in farm sector: a portfolio balance approach", **Amer. J. Ag. Econ.**, v.54, p.163-174.

Plaxico, J.S. (1979), "Implications of divergence in sources of returns in agriculture", **Amer. J. Ag. Econ.**, v.61, p.1098-1102.

Plaxico, J.S. and D.D. Kletke (1979), "The value of unrealized farm land capital gains", **Amer. J. Ag. Econ.**, v.61, p.327-330.

Pope, C.A. (1985), "Agricultural production and consumptive use components of rural land value in Texas", **Amer. J. Ag. Econ.**, v.67, p.81-86.

Pope, C.A. and H.L. Goodwin Jr. (1984), "Impacts of consumptive demand on rural land values", **Amer. J. Ag. Econ.**, v.66, p.750-754.

Reinsel, R.D. and E.I. Reinsel (1979), "The economics of asset values and current income in farming", **Amer. J. Ag. Econ.**, v.61, p.1093-1097.

Robison, L.J., D.A. Lins and R. Venkataraman (1985), "Cash rents and land values in U.S. agriculture", **Amer. J. Ag. Econ.**, v.67, p.794-805.

Statistics Canada (1985), **Canada Year Book**, catalogue 11-402/85.

Statistics Canada (1976-1986), **Farm Wages in Canada**, catalogue 21-002.

Statistics Canada (1940-1978), **Net Value of Agricultural Production**, catalogue 21-003b.

Statistics Canada (1969-1984), **Farm Net Income**, catalogue 21-202.

Statistics Canada (1987), **Agriculture Economics Statistics**, catalogue 21-603E.

Statistics Canada (1981), **1981 Census of Canada:** catalogue 62-001 (1960-1986), cat. 62-518 (1953-1960), cat. 62-502 (1926-1952).

Statistics Canada (1987), **Census Canada, 1986: Agriculture**, catalogue 96-102.

Tweeten, L. (1969), "Theories explaining the persistence of low resource returns in a growing farm economy", **Amer. J. Ag. Econ.**, p.798-817.

Tweeten, L. (1981), "Farmland pricing and cash flow in an inflationary economy", Ag. Exper. Station, Oklahoma State University, Research Report P-811, p.1-39.

Tweeten, L. (1982), "Macroeconomics in crisis: agriculture in an underachieving economy", **Amer. J. Ag. Econ.**, v.64, p.853-865.

Tweeten, L. (1985), "Are current U.S. farm commodity programs outdated?: Arguments in the affirmative", mimeograph of paper presented at Western Ag. Econ. Assoc. annual meeting, Saskataoon, Saskatchewan.

Tweeten, L. and T.R. Nelson (1966), "Sources and repercussions of changing U.S. farm estate values", Ag. Exper. Station, Oklahoma State University, Technical Bulletin T-120, p.1-51.

Tweeten, L. and L. Quance (1971), "The impact of input price inflation on the United States farming industry", **Canad. J. Ag. Econ.**, v19, p.35-48.

Tweeten, L. and F.H. Tyner (1966), "A utility concept of net social cost: a criterion for public policy", **Ag. Ec. Res.**, v.(XVIII), no.2, p.33-42.

Vandeveer, L.R. (1985), "Issues in agricultural land markets; an empirical perspective", **South. J. Ag. Econ.**, p.75-83.

Vantreese, V.L., J.R. Skees and M.R. Reed (1986), "Using capitalization theory to model farmland prices", **N. Cent. J. Ag. Econ.**, no.1, p.135-142.

Van Horne, J.C. (1971), **Fundamentals of Financial Management**, Prentice-Hall Inc., Englewood Cliffs, NJ.

Wilson, M. (1985), **Tax Issues in Agriculture: A Discussion**, Paper by the Canadian Minister of Finance, January, 1985.

White, F.C. and W.N. Musser (1980), "Inflation effects on farm financial management", **Amer. J. Ag. Econ.**, v.62, p.1060-1064.

APPENDIX 1

WORKSHEET TABLES AND WORKING VARIABLES

1.1 Canadian Aggregate Data.

1.2 Alberta Aggregate Data.

1.3 Working Variables: Definitions and Assumptions

APPENDIX 1.1

CANADIAN AGGREGATE DATA

TABLE A1.1 Canadian aggregate farm data and data analysis. Dollars ('000) reported in (A) nominal and (B) real dollar terms.

A) CURRENT $

YEAR[1,19]	LAND[2]	LAND & BLDG.[3]	MACHINERY & VEHICLES[4]	LIVESTOCK[5]	OTHER ASSETS[6]	TOTAL ASSETS[7]	LIABILITIES FARM DEBT[8]	OWNER EQUITY (NET WORTH)[9]	ANNUAL CHANGE IN NET WORTH[10]	NEW INVESTMENT[11]	DEPR'N[12]
1969	10218849	18626364	3926208	2666800	4646670	28054147	4393500	23660647	---	1654264	648379
1970	10242655	18736363	3922979	3139658	6047036	28948035	4310000	24638035	977388	1575550	660619
1971	10379401	18911982	3984961	3065088	6469496	29341507	4564296	24777211	139176	987940	648369
1972	11336175	18349579	4124931	3761176	6094653	32120338	4630767	27489571	2712360	1300614	687046
1973	13637181	22232643	4517817	4907390	7212868	38971939	5557026	33414913	5925342	1699111	868672
1974	18215102	29020886	5705580	6092915	6849656	46669017	6529713	40139304	6724391	2107284	942476
1975	23230003	36640600	7616692	4126800	9148782	57431874	7828690	49603184	9463880	2695616	1108559
1976	27527048	43498491	9026870	4446802	8886225	64857388	8057948	56799440	7196256	2181229	1340397
1977	32223168	49932140	10074055	4456880	8721470	73184563	10306717	62877846	6078406	286446	1601472
1978	38626662	59222721	11463643	6114973	8795941	83687178	12013367	71673811	8795965	4411674	1716627
1979	48337347	73076606	13369098	8830528	13281002	108557236	14156476	94400760	22726949	6132472	2012663
1980	61717748	91943328	15069961	9519521	13763614	130296444	15875876	114420568	20019809	4438786	2364236
1981	69784228	103221163	17431062	9868564	16416061	145739450	18117958	127621492	13200923	3990671	2626996
1982	70702656	103552908	18371361	8554308	18265125	149743703	19805845	129937858	2316367	2578282	2719846
1983	66170936	99316326	18811640	8017828	21050169	148195968	21249491	126946477	-2991381	2390076	2738414
1984	65436144	94957432	18648643	8117940	22132489	145056510	21584498	123472012	-3474465	2311166	2707316
1985	60793696	88302571	18478806	8398691	26368601	141538663	22110110	119428553	-4043459	2419604	2622468
1986	56967590	81952744	18800565	8714495	26477889	135946713	22700000	113246713	-6182840	1928866	2618654

B) CONSTANT $

YEAR[1,19]	LAND[2]	LAND & BLDG.[3]	MACHINERY & VEHICLES[4]	LIVESTOCK[5]	OTHER ASSETS[6]	TOTAL ASSETS[7]	LIABILITIES FARM DEBT[8]	OWNER EQUITY (NET WORTH)[9]	ANNUAL CHANGE IN NET WORTH[10]	NEW INVESTMENT[11]	DEPR'N[12]
1969	25231232	41062726	9692119	7298286	11226368	69269509	10848148	58421361	---	4084678	1334289
1970	24921382	40725944	9544961	7639071	12279896	70189866	10486618	59703248	1281887	3633464	1339462
1971	24082137	39238937	9060234	7111527	12667044	68077743	10590014	57487729	-2215519	2292203	1272296
1972	25929084	40606787	9105808	8280740	13453961	71347326	10663946	60683380	3195652	2871654	1295906
1973	27953921	44914634	9126903	8913919	14776632	78731188	11126313	67604875	6921495	3432640	1330446
1974	32760975	52196636	10261799	9159919	12319520	83937082	11744088	72192994	4588119	3790075	1616246
1975	36144504	60165189	12341036	6776356	16022631	94305212	12854992	81450221	9257227	4409879	1620282
1976	43142707	67436420	13995147	6697367	13775842	102104477	14043330	88061147	6610926	3361760	2078136
1977	46841881	70726411	14269200	6312874	12353369	103660854	14598749	89062104	1000958	378966	2120731
1978	50494052	77415322	14971962	7993429	8663583	109264284	15703746	93560538	4498433	8767168	2242619
1979	57644461	86996962	15903686	10612633	16822021	129234804	16852948	112381857	18821319	6110066	2396016
1980	66076956	98440394	16134863	10192207	14736204	139503688	16997726	122505962	10124105	4752448	2620697
1981	66651603	96687548	16649152	9234541	14726941	139197182	17504640	121692542	-813420	3811630	2699114
1982	61803021	90518276	16050882	8351659	16966016	130894846	17312802	113582044	-8110498	2263716	2377467
1983	56999112	83040406	15728803	7639960	17600476	123909673	17767133	106142540	-7439504	1998390	2287972
1984	52728561	76516867	15160270	7347267	17634399	116886793	17392827	99493966	-6648574	1862342	2161669
1985	46944861	68187314	14267804	6479296	20361864	109296269	17073448	92222821	-7271145	1868575	2025072
1986	42229496	60750737	13936683	6459967	19627790	100775176	16827279	83947897	-8274924	1429842	1941107

TABLE A1.1 (con.)

A) CURRENT $

YEAR	d INVENTORY (LVSTK,CROPS)[13][14]	d IN LIABILITIES[15]	d OTHER ASSETS[16]	NET INVESTMENT[16]	NOMINAL CAPITAL GAINS[17]	CPI/FAMILY LIVING INDEX (Dec. 31) 1981=100[18]	ANNUAL % d IN LIVING INDEX[19]	ANNUAL d IN PURCHASING POWER OF NET WORTH[20]	REAL CAPITAL GAINS ON FARM ASSETS[21]	NOMINAL CAPITAL GAINS ON R. ESTATE[22]	REAL CAPITAL GAINS ON R.ESTATE[23]
1969	285819	---	---	---	---	40.5	---	---	---	---	---
1970	62997	83600	628703	1806231	-922843	41.1	0.016	-363526	-1286309	112009	-136967
1971	172252	-264296	461319	608856	-569686	43.1	0.049	-1206704	-1776363	173619	-648348
1972	-264071	-266471	612176	796403	1916957	45.3	0.051	-1403180	613777	1437597	500960
1973	571368	-726250	572615	1460264	4407078	49.5	0.093	-3098071	1369008	2863204	1621941
1974	-76361	-972686	-939632	-717065	7442256	55.6	0.123	-4546460	2495796	6768043	3211732
1975	261770	-1298977	2272776	2612627	6551253	60.9	0.095	-4728361	1922892	7619714	4128995
1976	207774	-1229266	-404180	-684832	7781067	64.5	0.059	-3357602	4423486	6655681	4264670
1977	216669	-1248769	-262408	-2638534	8608940	70.0	0.085	-5946587	2862353	8435640	1713385
1978	209631	-1706650	-2481273	-1281946	9867910	76.5	0.084	-5981361	4006539	9290581	4341373
1979	26575	-2143109	5769409	6766696	16080264	84.0	0.098	-9254978	6806277	13663067	6609514
1980	-230568	-1719400	539951	673651	15346268	93.4	0.112	-12884208	6542061	16066720	6577624
1981	811561	-2242082	920600	663965	12336939	104.7	0.121	-16440286	-3103349	11277636	-1210379
1982	6331	-1667667	2736820	812670	1403696	114.4	0.093	-12036176	-10634461	331746	-9261862
1983	-615690	-1443646	3097549	691714	-3663096	119.6	0.045	-5770294	-9453369	-4226583	-8750961
1984	-968746	-336007	2164305	464403	-3926069	124.1	0.038	-4646686	-8574655	-4368883	-7931706
1985	419623	-526616	2753266	2464649	-6498098	129.6	0.044	-6196730	-11694738	-8654861	-10497197
1986	974044	-689684	361051	-43647	-6139193	134.9	0.042	-4722215	-10681408	-5349827	-9767161

B) CONSTANT $

YEAR	d INVENTORY (LVSTK,CROPS)[13][14]	d IN LIABILITIES[15]	d OTHER ASSETS[16]	NET INVESTMENT[16]	NOMINAL CAPITAL GAINS[17]	CPI/FAMILY LIVING INDEX (Dec. 31) 1981=100[18]	ANNUAL % d IN LIVING INDEX[19]	ANNUAL d IN PURCHASING POWER OF NET WORTH[20]	REAL CAPITAL GAINS ON FARM ASSETS[21]	NOMINAL CAPITAL GAINS ON R. ESTATE[22]	REAL CAPITAL GAINS ON R.ESTATE[23]
1969	705719	---	---	---		40.5			---		---
1970	153277	361530	1806330	4609136		41.1			-3227232		-326762
1971	399667	-103398	696494	1902664		43.1			-4118163		-1467007
1972	-582938	-73031	896991	1816361		45.3			1360271		1267860
1973	1164279	-662368	216461	2904471		49.5			3917024		4408037
1974	-126631	-617776	-2966909	-1276363		55.6			5963502		7261904
1975	429836	-1110904	3147677	5056096		60.9			4201131		7969361
1976	322138	-1166336	-1160307	-712906		64.5			7323627		7271231
1977	306697	-656419	-1237361	-3236648		70.0			4237606		3268991
1978	274027	-1104998	-3666378	-1182716		76.5			5691144		6669911
1979	24494	-1149208	6437096	9926464		84.0			9794666		9600640
1980	-246566	-144770	-630626	1309594		93.4			8814611		11444432
1981	775149	-306914	-217569	1554694		104.7			-2167664		147154
1982	4609	-6182	1616073	1467601		114.4			-9798289		-8069272
1983	-614968	-464331	2148484	667613		119.6			-6327117		-7477071
1984	-786617	374306	1276463	559924		124.1			-7199497		-8523536
1985	324033	319378	1663449	2040303		129.6			-9311606		-8329564
1986	722049	246169	-484328	-7376		134.9			-8287648		-7436577

TABLE A1.1 (con.)

A) CURRENT $

YEAR	NET FARM INCOME[24]	INTEREST ON DEBT[25]	GROSS FARM INCOME[26]	IMPUTED RETURN TO MANAGEMENT[27]	IMPUTED RETURN TO OPER. LABOR[28]	RETURN TO OWNER'S EQUITY[29]	RETURN TO PRODUCTION ASSETS[30]	IMPUTED FARM RENT[31]
1969	1606973	297639	4665006	232790	3120	1270083	1607702	449128
1970	1276636	270629	4433134	221667	3372	1060606	1321236	399832
1971	1438646	286663	4852622	242631	3456	1192486	1469121	444090
1972	1627567	323014	6384263	269213	3696	1364646	1677663	464364
1973	3197564	332666	7766446	387632	4126	2806614	3136280	496692
1974	3492461	472867	9110349	466617	4636	3032996	3604985	760516
1975	4043623	642109	10665456	620273	5592	3509656	4061766	865365
1976	3216632	674679	10601632	625063	6384	2604066	3366745	978927
1977	2666602	726914	10664606	629244	7428	2110930	2846644	1048319
1978	3204147	920204	12436271	631764	7800	2654563	3574767	1262956
1979	3661336	1330648	14666866	720443	8292	2613601	4144460	1524611
1980	3060030	1606641	15666706	764336	8748	2277747	3064366	1906696
1981	4661360	2422291	19741916	867066	9372	3604612	5067203	2016330
1982	3476277	2240032	19020659	861430	10093	2613766	4763767	2077211
1983	2091365	1663706	18324636	916227	10762	1764376	3626061	2099136
1984	3371632	1871917	19681191	979600	11292	2360716	4352633	2037146
1985	4320613	1636204	20606573	1030279	11656	3276102	5114306	1959903
1986	5630268	1614949	21673164	1078666	12432	4761610	6666665	1777979

B) CONSTANTS

YEAR	NET FARM INCOME[24]	INTEREST ON DEBT[25]	GROSS FARM INCOME[26]	IMPUTED RETURN TO MANAGEMENT[27]	IMPUTED RETURN TO OPER. LABOR[28]	RETURN TO OWNER'S EQUITY[29]	RETURN TO PRODUCTION ASSETS[30]	IMPUTED FARM RENT[31]
1969	3716462	734911	11495915	674791	7704	3136657	3670669	1100956
1970	5103736	656466	10766214	639311	8204	2666220	3214664	972629
1971	3337691	616706	11256964	662949	8016	2766724	3366431	1030372
1972	3692641	713066	11666790	664290	8159	2900393	3703469	1026066
1973	6459726	672053	16659566	763470	8339	5667906	6339069	1003419
1974	6261367	660516	15366520	619270	8696	5463413	6303026	1346663
1975	6639611	699151	17346664	667443	9162	5762966	6653149	1463634
1976	4966321	1046614	16261600	614060	9696	4161242	5207367	1517717
1977	3762602	1026207	14692750	749636	10621	3662733	4630940	1464671
1978	4263003	1202661	16266264	612763	10196	3470044	4672626	1660923
1979	4227761	1664344	17367666	666364	9671	3349526	4933669	1616252
1980	3396633	1720173	17009321	660466	9366	2436701	4156673	2046366
1981	4356619	2313664	16666694	642766	9661	3404663	5716437	1927727
1982	3037630	1956979	16633391	631670	8622	2197336	4156406	1616744
1983	2260207	1656262	16321616	766676	8690	1476231	3633613	1766129
1984	2717626	1666974	15766616	769331	9099	1916696	2607572	1641636
1985	3336636	1417916	15611639	796562	8624	2632036	3640946	1613436
1986	4321916	1346403	15661667	799696	9216	3513104	4666696	1317966

TABLE A1.1 (con.)

A) CURRENT $

	RETURN TO FARM ASSETS:[32]					RETURN TO FARM REAL ESTATE:[33]				
YEAR	NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	CURRENT RETURN[c]	EXPECTED NOMINAL RETURN[e]	EXPECTED REAL RETURN[f]	NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	ANNUAL RETURN: IMPUTED RENT[c]	IMPUTED NOMINAL ECONOMIC RETURN[e]	IMPUTED REAL ECONOMIC RETURN[f]
1970	-0.033	-0.046	0.047	0.014	0.001	0.007	-0.008	0.024	0.031	0.016
1971	-0.020	-0.062	0.061	0.031	-0.011	0.010	-0.039	0.027	0.037	-0.012
1972	0.066	0.018	0.057	0.123	0.076	0.085	0.030	0.027	0.112	0.067
1973	0.136	0.042	0.097	0.235	0.139	0.212	0.099	0.027	0.239	0.128
1974	0.181	0.064	0.090	0.261	0.164	0.305	0.144	0.034	0.339	0.178
1975	0.143	0.041	0.087	0.229	0.126	0.263	0.142	0.031	0.293	0.173
1976	0.136	0.077	0.068	0.194	0.136	0.187	0.117	0.027	0.214	0.144
1977	0.131	0.050	0.043	0.174	0.084	0.148	0.039	0.024	0.172	0.083
1978	0.138	0.066	0.049	0.186	0.104	0.196	0.087	0.026	0.221	0.112
1979	0.192	0.061	0.050	0.242	0.131	0.234	0.113	0.026	0.260	0.139
1980	0.178	0.060	0.036	0.214	0.096	0.256	0.117	0.028	0.284	0.143
1981	0.096	-0.024	0.046	0.141	0.022	0.123	-0.013	0.022	0.145	0.009
1982	0.010	-0.073	0.033	0.042	-0.040	0.003	-0.096	0.020	0.023	-0.078
1983	-0.026	-0.063	0.024	-0.000	-0.039	-0.041	-0.085	0.020	-0.021	-0.064
1984	-0.027	-0.056	0.029	0.003	-0.028	-0.044	-0.080	0.021	-0.023	-0.059
1985	-0.045	-0.061	0.026	-0.018	-0.045	-0.070	-0.111	0.021	-0.049	-0.090
1986	-0.043	-0.077	0.046	0.003	-0.030	-0.072	-0.111	0.020	-0.052	-0.090

B) CONSTANT $

YEAR	NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	CURRENT RETURN[c]	EXPECTED NOMINAL RETURN[e]	EXPECTED REAL RETURN[f]	NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	ANNUAL RETURN: IMPUTED RENT[c]	IMPUTED NOMINAL ECONOMIC RETURN[e]	IMPUTED REAL ECONOMIC RETURN[f]
1970		-0.047	0.046[d]		-0.003		-0.005	0.024[d]		-0.001
1971		-0.058	0.046		-0.010		-0.037	0.027		-0.029
1972		0.026	0.054		0.075		0.032	0.027		0.040
1973		0.055	0.089		0.144		0.109	0.027		0.119
1974		0.076	0.080		0.156		0.182	0.034		0.171
1975		0.050	0.078		0.128		0.163	0.031		0.161
1976		0.078	0.055		0.133		0.121	0.027		0.126
1977		0.042	0.039		0.081		0.040	0.024		0.065
1978		0.055	0.045		0.100		0.096	0.026		0.102
1979		0.090	0.046		0.136		0.124	0.026		0.131
1980		0.068	0.032		0.100		0.132	0.026		0.138
1981		-0.016	0.041		0.025		0.001	0.022		0.005
1982		-0.075	0.036		-0.041		-0.082	0.020		-0.076
1983		-0.064	0.023		-0.040		-0.063	0.020		-0.076
1984		-0.056	0.026		-0.030		-0.079	0.021		-0.072
1985		-0.080	0.034		-0.046		-0.109	0.021		-0.102
1986		-0.076	0.044		-0.031		-0.109	0.020		-0.102

TABLE A1.1 (con.)

A) CURRENT $ GROWTH RATES:[34] SOLVENCY RATIOS:[35] EFFICIENCY RATIOS:[36]

YEAR	GROWTH IN REAL ESTATE (NOMINAL)[a] (endA/begA)-1	GROWTH IN EQUITY (NOMINAL)[b] (endE/begE)-1	GROWTH IN FARM ASSETS (NOMINAL)[c]	1.CAPITAL RATIO[a] A/L	2.EQUITY RATIO[b] E/A	3.LEVERAGE RATIO[c] L/E	1.TURNOVER[a] A/GI	2.SCALE[b] GI/A
				6.39	0.843	0.186	6.03	0.166
1970	0.007	0.037	-0.039	6.69	0.851	0.176	6.51	0.154
1971	0.010	0.010	-0.023	6.43	0.844	0.184	6.05	0.165
1972	0.086	0.109	0.077	6.69	0.851	0.176	6.00	0.167
1973	0.212	0.216	0.163	7.01	0.857	0.166	5.02	0.199
1974	0.306	0.201	0.223	7.15	0.860	0.163	5.12	0.195
1975	0.263	0.236	0.166	7.34	0.864	0.158	5.44	0.184
1976	0.187	0.145	0.167	7.27	0.862	0.159	6.27	0.159
1977	0.148	0.107	0.152	7.10	0.859	0.164	6.85	0.146
1978	0.186	0.136	0.169	6.96	0.856	0.168	6.72	0.149
1979	0.234	0.319	0.224	7.67	0.870	0.150	7.44	0.134
1980	0.268	0.212	0.206	8.21	0.878	0.139	8.20	0.122
1981	0.123	0.115	0.108	8.04	0.876	0.142	7.38	0.136
1982	0.003	0.016	0.011	7.56	0.868	0.152	7.87	0.127
1983	-0.041	-0.023	-0.026	6.97	0.857	0.167	8.08	0.124
1984	-0.044	-0.027	-0.031	6.72	0.851	0.175	7.40	0.135
1985	-0.070	-0.033	-0.063	6.40	0.844	0.185	6.87	0.146
1986	-0.072	-0.052	-0.061	5.99	0.833	0.200	6.30	0.159

B) CONSTANT $

YEAR			cmf[d]	Mellichar[e]					
1970	-0.008	0.022	-0.055	-0.054	6.69	0.851	0.176	6.51	0.154
1971	-0.037	-0.037	-0.089	-0.072	6.43	0.844	0.184	6.05	0.165
1972	0.032	0.066	0.024	0.021	6.69	0.851	0.176	6.00	0.167
1973	0.109	0.112	0.085	0.060	7.01	0.857	0.166	5.02	0.199
1974	0.162	0.069	0.086	0.076	7.15	0.860	0.163	5.12	0.195
1975	0.153	0.126	0.066	0.048	7.34	0.864	0.158	5.44	0.184
1976	0.121	0.081	0.090	0.069	7.27	0.862	0.159	6.27	0.159
1977	0.049	0.011	0.046	0.047	7.10	0.859	0.164	6.85	0.146
1978	0.096	0.061	0.064	0.064	6.96	0.856	0.168	6.72	0.149
1979	0.124	0.201	0.106	0.095	7.67	0.870	0.150	7.44	0.134
1980	0.132	0.090	0.076	0.069	8.21	0.878	0.139	8.20	0.122
1981	0.001	-0.005	-0.016	-0.027	8.04	0.876	0.142	7.38	0.136
1982	-0.082	-0.068	-0.080	-0.083	7.56	0.868	0.152	7.87	0.127
1983	-0.083	-0.065	-0.073	-0.073	6.97	0.857	0.167	8.08	0.124
1984	-0.079	-0.083	-0.069	-0.068	6.72	0.851	0.175	7.40	0.135
1985	-0.109	-0.072	-0.084	-0.096	6.40	0.844	0.185	6.87	0.146
1986	-0.109	-0.090	-0.080	-0.091	5.99	0.833	0.200	6.30	0.159

TABLE A1.1 (con.)

A) CURRENT $

	CANADA: PROFITABILITY RATIOS:[37]					EARNINGS RATIOS: P/E[38]		CANADA: WEIGHTING RATIOS:[39]		
YEAR	1.PROFIT FOR BUSINESS[a] (ROA) (NFI+INT-RO1-ROM)/A	2.PROFIT FOR OWNER/OPERATOR[b] (ROE)(1) NFI/E	3.PROFIT FOR OWNER[c] (ROE)(2) (NFI-RO1-ROM)/E	4.BANK RATE:[d] INTEREST ON SAVINGS	5.PROFIT FOR LENDER[e] (ROL) INT/L	1.FARM PRODN ASSETS/ $ EARNINGS[a]	2.VALUE OF REAL ESTATE/ $ IMPUTED RENT[b]	1.LAND/ TOTAL ASSETS[c]	2.REAL ESTATE/ TOTAL ASSETS[a]	3.LAND/ REAL ESTATE[b]
1969	0.056	0.064	0.054	0.060	0.066	8.03	37.02	0.364	0.593	0.615
1970	0.046	0.052	0.043	0.062	0.063	6.51	41.06	0.355	0.580	0.612
1971	0.050	0.058	0.048	0.045	0.066	6.06	38.08	0.354	0.576	0.614
1972	0.052	0.059	0.049	0.048	0.067	6.00	39.62	0.361	0.566	0.616
1973	0.061	0.096	0.084	0.064	0.060	6.02	44.76	0.356	0.570	0.622
1974	0.075	0.087	0.076	0.086	0.072	6.12	38.67	0.390	0.622	0.628
1975	0.071	0.082	0.071	0.078	0.069	5.44	41.36	0.404	0.636	0.634
1976	0.061	0.057	0.047	0.076	0.074	6.27	44.43	0.423	0.660	0.640
1977	0.039	0.042	0.034	0.080	0.070	6.91	47.63	0.440	0.662	0.646
1978	0.043	0.046	0.037	0.071	0.077	6.72	46.09	0.462	0.709	0.652
1979	0.036	0.038	0.030	0.101	0.084	7.44	47.93	0.446	0.673	0.661
1980	0.030	0.027	0.020	0.112	0.101	8.20	48.26	0.474	0.706	0.671
1981	0.041	0.036	0.026	0.154	0.134	7.30	51.14	0.479	0.706	0.676
1982	0.032	0.027	0.019	0.116	0.113	7.87	49.05	0.472	0.692	0.683
1983	0.024	0.021	0.014	0.089	0.088	8.09	47.31	0.460	0.670	0.686
1984	0.030	0.027	0.019	0.077	0.091	7.40	46.61	0.461	0.666	0.689
1985	0.036	0.036	0.027	0.081	0.083	6.87	46.06	0.430	0.624	0.690
1986	0.048	0.051	0.042	0.086	0.080	6.30	46.09	0.419	0.603	0.695

B) CONSTANT $

YEAR	1.PROFIT FOR BUSINESS (ROA)	2.PROFIT FOR OWNER/OPERATOR (ROE)(1)	3.PROFIT FOR OWNER (ROE)(2)	4.BANK RATE: INTEREST ON SAVINGS	5.PROFIT FOR LENDER (ROL)	1.FARM PRODN ASSETS/ $ EARNINGS	2.VALUE OF REAL ESTATE/ $ IMPUTED RENT	1.LAND/ TOTAL ASSETS	2.REAL ESTATE/ TOTAL ASSETS	3.LAND/ REAL ESTATE
1969	0.056	0.064	0.054	0.060	0.068	8.03	37.02	0.364	0.593	0.615
1970	0.046	0.052	0.043	0.047	0.063	6.51	41.06	0.355	0.580	0.612
1971	0.050	0.058	0.048	-0.004	0.066	6.06	38.08	0.354	0.576	0.614
1972	0.052	0.059	0.049	-0.011	0.067	6.00	39.62	0.361	0.566	0.616
1973	0.061	0.096	0.084	-0.030	0.060	6.02	44.76	0.356	0.570	0.622
1974	0.075	0.087	0.076	-0.030	0.072	6.12	38.67	0.390	0.622	0.628
1975	0.071	0.082	0.071	-0.025	0.069	5.44	41.36	0.404	0.636	0.634
1976	0.061	0.057	0.047	0.015	0.074	6.27	44.43	0.423	0.660	0.640
1977	0.039	0.042	0.034	-0.035	0.070	6.91	47.63	0.440	0.662	0.646
1978	0.043	0.046	0.037	-0.013	0.077	6.72	46.09	0.462	0.709	0.652
1979	0.036	0.038	0.030	0.003	0.084	7.44	47.93	0.446	0.673	0.661
1980	0.030	0.027	0.020	0.000	0.101	8.20	48.26	0.474	0.706	0.671
1981	0.041	0.036	0.026	0.033	0.134	7.30	51.14	0.479	0.706	0.676
1982	0.032	0.027	0.019	0.022	0.113	7.87	49.05	0.472	0.692	0.683
1983	0.024	0.021	0.014	0.024	0.088	8.09	47.31	0.460	0.670	0.686
1984	0.030	0.027	0.019	0.039	0.091	7.40	46.61	0.461	0.666	0.689
1985	0.036	0.036	0.027	0.017	0.083	6.87	46.06	0.430	0.624	0.690
1986	0.048	0.051	0.042	0.016	0.080	6.30	46.09	0.419	0.603	0.695

TABLE A1.1 (con.)

A) CURRENT $

YEAR	POTATOES	WHEAT	OATS	BARLEY	RYE	FLAX	RAPE	TOTAL VALUE CROP INVENTORY[14,15]
1969	69087	1117897	166075	235292	14012	39215	43480	1874858
1970	63966	865937	178106	259155	14978	69833	95517	1846611
1971	46864	789868	167324	291376	15799	67329	137093	1807853
1972	80232	750204	166071	340497	16870	50075	124686	1830634
1973	124807	957804	277222	492102	29177	93418	162724	2177264
1974	111997	1269516	321712	672757	34033	71481	171116	2652654
1975	146116	1311910	292617	617904	30907	86799	213660	2679004
1976	117697	1662947	268200	505954	25569	64687	193662	2619626
1977	102898	1647703	243237	656788	28027	78049	253588	2918286
1978	127316	1779460	229595	629510	40183	113079	564910	3484023
1979	128292	2338627	253666	679724	75833	179976	653565	4209874
1980	229752	2055532	207935	940013	64502	110644	645048	4143326
1981	215716	2674446	270587	1162271	74879	90755	389308	4887963
1982	192088	2798197	262268	1192091	60136	126098	347333	4978208
1983	265611	2653098	264901	656209	65600	77910	462136	4666663
1984	166214	1683463	247779	636072	66840	81184	523126	3693677
1985	---	---	---	---	---	---	---	5066581
1986	---	---	---	---	---	---	---	4913978

B) CONSTANT $

YEAR	POTATOES	WHEAT	OATS	BARLEY	RYE	FLAX	RAPE	TOTAL VALUE CROP INVENTORY[14,15]
1969	69087	1117897	166075	235292	14012	39215	43480	4218788
1970	63966	865937	178106	259155	14978	69833	95517	3771978
1971	46864	789868	167324	291376	15799	67329	137093	3572837
1972	80232	750204	166071	340497	16870	50075	124686	3462975
1973	124807	957804	277222	492102	29177	93418	162724	4574063
1974	111997	1269516	321712	672757	34033	71481	171116	5023968
1975	146116	1311910	292617	617904	30907	86799	213660	4579494
1976	117697	1662947	268200	505954	25569	64687	193662	4482712
1977	102898	1647703	243237	656788	28027	78049	253588	4297920
1978	127316	1779460	229595	629510	40183	113079	564910	4714618
1979	128292	2338627	253666	679724	75833	179976	653565	5218449
1980	229752	2055532	207935	940013	64502	110644	645048	4660869
1981	215716	2674446	270587	1162271	74879	90755	389308	4887963
1982	192088	2798197	262268	1192091	60136	126098	347333	4492988
1983	265611	2653098	264901	656209	65600	77910	462136	3980941
1984	166214	1683463	247779	636072	66840	81184	523126	2938411
1985	---	---	---	---	---	---	---	3012418
1986	---	---	---	---	---	---	---	3642682

APPENDIX 1.2

ALBERTA AGGREGATE DATA

TABLE A1.2 Alberta Aggregate Farm Data and Data Analysis. Dollars (000) reported in nominal and real dollar terms.

A) CURRENT $

YEAR[1,10]	LAND[2]	LAND & BLDG[3]	MACHINERY & VEHICLES[4]	LIVESTOCK[5]	OTHER ASSETS[6]	TOTAL ASSETS[7]	LIABILITIES, FARM DEBT[8]	OWNER EQUITY (NET WORTH)[9]	ANNUAL CHANGE IN NET WORTH[10]	NEW INVESTMENT[11]	DEPR'N[12]
1968	2640002	3635060	863831	686184	---	---	766571		---	---	18840
1969	2494361	3663366	873494	730862	816530	5984234	834296	5150029	5150029	262304	18675
1970	2460236	3632626	874233	793016	811666	6111444	809260	5302184	152156	231561	19237
1971	2464116	3630252	867446	803866	1059664	6261217	932596	5328619	26435	137061	20679
1972	2966514	4143591	905651	1016172	1096029	7163642	1036563	6126090	796471	165343	21762
1973	3632064	5161261	986590	1366491	1394250	8932502	1289061	7643511	1516421	214440	24405
1974	4003966	6975770	1275661	1366306	1401952	11019661	1637210	9482662	1839152	325510	31976
1975	6306346	8957060	1726606	1024339	1767366	13466374	1764402	11701972	2219309	437966	41409
1976	7603036	10627526	2110063	1126464	1711029	15574064	2029710	13544346	1842374	362660	46302
1977	8678672	12523061	2436616	1099604	1466669	17642272	2233466	15308604	1764456	59647	54176
1978	10639396	14942672	2791066	1710604	1946259	20492914	2603073	17889841	2681037	796567	63744
1979	15136339	21172490	3297240	2470367	2140166	29088279	3060789	26027467	8137646	1062496	75696
1980	19464709	27137560	3642797	2661751	2062766	36614922	3428790	32186142	6158656	1161660	586664
1981	21601999	29961159	4362216	2631666	1984237	36769476	4063427	34696049	2609907	1227611	666936
1982	21906796	30260771	4656606	2624214	3224600	40565590	4654466	36011122	1315073	831622	690104
1983	20679606	28445126	4602646	2497341	3674956	39520272	4936626	34581647	-1429475	772067	665472
1984	19311306	26463966	4495647	2496336	3660096	37256047	5062004	32193043	-2388604	677996	660062
1985	16152711	24666726	4464253	2176420	4776466	36285666	5240632	31044954	-1148089	519711	646710
1986	16637769	22677390	4696613	2276661	6736669	35396633	5360000	30046633	-996321	236664	643111

B) CONSTANT $

YEAR[1,10]	LAND[2]	LAND & BLDG[3]	MACHINERY & VEHICLES[4]	LIVESTOCK[5]	OTHER ASSETS[6]	TOTAL ASSETS[7]	LIABILITIES, FARM DEBT[8]	OWNER EQUITY (NET WORTH)[9]	ANNUAL CHANGE IN NET WORTH[10]	NEW INVESTMENT[11]	DEPR'N[12]
1969	8156691	8798415	2156776	1804673	2016124	14776067	2059765	12716122	---	622973	44636
1970	8067671	8594861	2137066	1929464	2219170	14869893	1969002	12900891	184669	663406	46605
1971	6717296	8190646	2012636	1966093	2466317	14527166	2163600	12363366	-537300	316006	47979
1972	6402961	9147069	1999671	2243206	2423996	15613701	2292611	13521170	1157796	364996	48064
1973	7337603	10467194	1993111	2766871	2796466	18046641	2604204	15441437	1920267	433236	49303
1974	8820063	12546349	2294696	2457366	2621499	19819930	2764781	17055149	1613713	565463	57514
1975	10366261	14709163	2036461	1661967	2666641	22112272	2897212	19215060	2159911	717560	67995
1976	11632612	16476766	3271400	1744860	2652759	24146635	3146669	20999966	1763926	646605	74667
1977	12576306	17736069	3442602	1557324	2106696	24647411	3163562	21663656	664673	64460	76737
1978	13967707	19533297	3646461	2236064	1370261	26766123	3402710	23366413	1701566	1028192	83325
1979	18021621	25205345	3925266	2960425	2647643	34626699	3643796	30966103	7599690	1252972	89995
1980	20551656	29055234	4114344	2732067	2229963	38131699	3671071	34460637	3475434	1266160	636646
1981	20632279	28616196	4166394	2418209	1616765	37019557	3681019	33138538	-1322096	1171939	636906
1982	19161047	26461723	3982347	2206461	2616661	35459432	3981176	31478253	-1660264	726942	603236
1983	17290640	23763646	3646536	2066076	3323544	33043706	4129286	28914421	-2563633	645992	573137
1984	15561156	21316653	3622600	2011564	3069376	30029183	4076972	25941211	-2973210	546330	532524
1985	14017537	19202107	3447300	1682176	3668406	28019669	4047052	23972936	-1969274	401321	500934
1986	12461669	16956777	3342116	1667614	4261942	26240647	3965961	22274747	-1698191	174669	476732

TABLE A1.2 (con.)

A) CURRENTS

YEAR	d INVENTORY (LVSTK,CROPS)[13]	d IN LIABILITIES[15]	d OTHER ASSETS[15]	NET INVESTMENT[16]	NOMINAL CAPITAL GAINS[17]	C.P.I./FAMILY LIVING INDEX (Dec. 31)[18] (1981=100)	ANNUAL % d LIVING INDEX[19]	ANNUAL d PURCHASING POWER OF NET WORTH[20]	REAL CAPITAL GAINS ON ASSETS[21]	NOMINAL CAPITAL GAIN R.ESTATE[22]	REAL CAPITAL GAIN R. ESTATE[23]
1968	61972	---	---	---	---						
1969	44746	-65634	824771	1036112	4111916	40.5				-72722	-72722
1970	32147	24946	99592	369107	-216963	41.1	0.016	-78661	-295504	-30833	-83167
1971	16749	-123336	217676	227669	-201224	43.1	0.049	-269300	-460634	-2273	-174061
1972	26312	-106965	-19342	44676	761866	45.3	0.051	-312660	439245	613339	401633
1973	204199	-250526	86477	230693	1268326	49.5	0.093	-706670	579658	1037670	557206
1974	-11709	-246137	-136933	-106240	1944391	55.6	0.123	-1166571	775621	1794509	934669
1975	90404	-227194	334412	602277	1617031	60.9	0.096	-1118476	601656	1962110	1126211
1976	61626	-265316	-69013	39666	1602719	64.5	0.059	-800661	1002068	1969646	1041420
1977	-73902	-203769	-193373	-466253	2229712	70.6	0.095	-1447609	761902	1695563	711209
1978	99636	-369606	-601643	-146796	2729627	76.5	0.084	-1496043	1234704	2419081	1171106
1979	74104	-467716	795996	1369366	6748260	84.0	0.098	-2551714	4196505	6229516	4163704
1980	162174	-367991	-343133	26017	6132629	93.4	0.112	-3601762	2630659	5965099	2026274
1981	69360	-634647	-241793	-260614	2769921	104.7	0.121	-4197702	-1437701	2023570	-601201
1982	-64909	-491041	1409290	974666	340206	114.4	0.093	-2336274	-2996069	299613	-2502917
1983	-211649	-364157	654397	346626	-1775201	119.6	0.045	-1571693	-3347194	-1616946	-3109696
1984	-350962	-123379	123566	-333633	-2064971	124.1	0.038	-1211277	-3206246	-1991169	-2966501
1985	-90906	-179626	967752	566921	-1737016	129.5	0.044	-1360666	-3067679	-1667236	-2609271
1986	623064	-199068	616060	626320	-1632640	134.9	0.042	-1252093	-3076634	-1969336	-2943299

B) CONSTANTS

YEAR	d INVENTORY (LVSTK,CROPS)[13]	d IN LIABILITIES[15]	d OTHER ASSETS[15]	NET INVESTMENT[16]	NOMINAL CAPITAL GAINS[17]	C.P.I./FAMILY LIVING INDEX (Dec. 31)[18] (1981=100)	ANNUAL % d LIVING INDEX[19]	ANNUAL d PURCHASING POWER OF NET WORTH[20]	REAL CAPITAL GAINS ON ASSETS[21]	NOMINAL CAPITAL GAIN R.ESTATE[22]	REAL CAPITAL GAIN R. ESTATE[23]
1969	110481					40.5					
1970	78217	96763	227643	613426		41.1			-720666		-393483
1971	36061	-194796	446163	662263		43.1			-1099656		-494111
1972	66664	-126611	-124463	121792		45.3			1036063		966160
1973	612323	-211593	42376	627634		49.5			1303234		1270194
1974	-21966	-160577	-425623	-79319		55.6			1693031		2079156
1975	163226	-132431	446746	1127263		60.9			1032706		2162614
1976	126397	-249636	-215660	132697		64.5			1661326		1767626
1977	-104263	-16793	-395461	-600667		70.6			1192659		1261302
1978	130242	-239157	-664467	-28536		76.5			1730601		1796207
1979	66314	-241087	934473	1944676		84.0			6656012		6072049
1980	162627	-27274	-476242	266714		93.4			3169721		3649668
1981	65202	-299546	-296262	92675		104.7			-1414075		-439037
1982	-74212	-106159	1265664	1156617		114.4			-2616301		-2164475
1983	-176669	-146107	646517	306366		119.6			-2960217		-2966174
1984	-262799	66313	31122	-197666		124.1			-2775664		-2406697
1985	-70197	31926	671654	533764		129.5			-2602037		-2114646
1986	369336	61161	492772	669216		134.9			-2369409		-2243330

TABLE A1.2 (con.)

A) CURRENTS

YEAR	NET FARM INCOME[24]	INTEREST ON DEBT[25]	GROSS FARM INCOME[26]	IMPUTED RETURN TO MANAGEMENT[27]	IMPUTED RETURN TO OPER. LABOR[28]	RETURN TO OWNER'S EQUITY[29]	RETURN TO PRODUCTION ASSETS[30]	IMPUTED RENT[31]
1968	335164	63636	884459	44223	3048	287883	341619	89170
1969	259780	61526	803268	40163	3248	207377	268902	84732
1970	219057	58495	768930	38447	3576	177036	235639	79271
1971	222640	67514	827657	41393	3824	177831	235346	87366
1972	317717	70065	999201	49960	3972	263786	333860	96050
1973	829886	75349	1468391	73420	4368	661670	827227	168167
1974	869326	117267	1753464	87673	5088	678584	893821	187797
1975	743566	128221	2018193	100910	6000	636658	765877	187610
1976	540406	159442	2016440	100822	6996	432590	592032	208094
1977	322650	164809	1913722	95636	8544	218478	383067	215344
1978	617867	208174	2416074	120804	8976	486107	696281	273159
1979	718732	307326	2938727	146936	9636	663180	870486	336364
1980	756062	362733	3336019	166761	10200	579111	941844	413973
1981	794256	545170	3999765	199988	10632	583646	1128818	443381
1982	544750	509637	3777487	188873	11544	344333	853970	466202
1983	346118	392386	3537184	176868	12264	156996	549362	485329
1984	290291	442317	3646986	182348	12732	95211	537528	483009
1985	450311	416762	3792042	189602	13236	247473	666225	448996
1986	1243992	408459	4320294	216015	13476	1014601	1422970	416908

B) CONSTANTS

YEAR	NET FARM INCOME[24]	INTEREST ON DEBT[25]	GROSS FARM INCOME[26]	IMPUTED RETURN TO MANAGEMENT[27]	IMPUTED RETURN TO OPER. LABOR[28]	RETURN TO OWNER'S EQUITY[29]	RETURN TO PRODUCTION ASSETS[30]	IMPUTED RENT[31]
1969	819210	181914	1983378	99169	8000	612041	693955	209215
1970	532985	142324	1870676	93644	8701	430741	573084	192674
1971	617049	133443	1920782	96039	8408	412601	546044	202682
1972	781362	164669	2205742	110287	8788	662307	730976	212030
1973	1272053	152220	2966446	148322	8824	1114906	1267126	319610
1974	1203622	218884	3153712	157600	9151	1036986	1247679	283800
1975	1220962	212166	3313946	165697	9062	1045413	1257598	307896
1976	837842	247197	3125284	156313	10847	670662	917679	322627
1977	457023	233157	2709236	135462	12102	309460	542616	305020
1978	807595	272123	3156267	157913	11733	638049	910172	357071
1979	856824	365863	3498485	174924	11471	670420	1036281	389231
1980	809468	368365	3670684	178834	10921	620033	1008398	443228
1981	760613	520697	3620215	191011	10166	567448	1078145	423401
1982	476180	445487	3301982	165099	10091	300990	746477	407520
1983	269396	328065	2957496	147875	10254	131267	459333	405794
1984	233017	366420	2936731	146837	10259	76721	433141	389209
1985	347731	323361	2926218	146411	10221	191098	614459	346715
1986	922159	382794	3202590	160130	9990	752040	1054833	309050

TABLE A1.2 (con.)

A) CURRENTS

YEAR	RETURNS TO TOTAL ASSETS:[32]					RETURNS TO FARM REAL ESTATE:[33]				
	NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	CURRENT RETURN	EXPECTED RATE OF NOMINAL RETURN[c]	EXPECTED RATE OF REAL RETURN[e]	NOMINAL CAPITAL GAIN[a]	REAL CAPITAL GAIN[b]	ANNUAL RETURN TO OWNER: IMPUTED RENT[c]	IMPUTED RATE OF NOMINAL RETURN[e]	IMPUTED RATE OF REAL RETURN[f]
1970	-0.036	-0.049	0.039	0.003	-0.010	-0.005	-0.023	0.022	0.014	-0.001
1971	-0.033	-0.075	0.039	0.006	-0.037	-0.001	-0.049	0.025	0.024	-0.025
1972	0.120	0.070	0.053	0.173	0.123	0.174	0.114	0.027	0.201	0.141
1973	0.180	0.081	0.066	0.267	0.186	0.260	0.134	0.036	0.289	0.173
1974	0.216	0.087	0.075	0.286	0.165	0.345	0.160	0.030	0.377	0.211
1975	0.147	0.046	0.059	0.216	0.115	0.284	0.162	0.027	0.311	0.189
1976	0.134	0.074	0.044	0.178	0.118	0.185	0.116	0.023	0.210	0.139
1977	0.143	0.060	0.025	0.168	0.075	0.175	0.067	0.020	0.199	0.087
1978	0.156	0.070	0.040	0.195	0.110	0.193	0.094	0.022	0.215	0.116
1979	0.320	0.206	0.042	0.372	0.247	0.417	0.278	0.022	0.439	0.300
1980	0.211	0.087	0.032	0.243	0.118	0.282	0.136	0.020	0.301	0.158
1981	0.077	-0.040	0.032	0.108	-0.008	0.104	-0.030	0.018	0.120	-0.013
1982	0.009	-0.077	0.022	0.031	-0.055	0.010	-0.084	0.019	0.020	-0.066
1983	-0.044	-0.083	0.014	-0.030	-0.069	-0.060	-0.103	0.016	-0.044	-0.087
1984	-0.052	-0.083	0.014	-0.038	-0.069	-0.070	-0.105	0.017	-0.053	-0.088
1985	-0.047	-0.083	0.018	-0.029	-0.065	-0.060	-0.101	0.017	-0.043	-0.084
1986	-0.050	-0.085	0.039	-0.011	-0.046	-0.060	-0.116	0.017	-0.063	-0.102

B) CONSTANTS

YEAR	NOMINAL CAPITAL GAIN	REAL CAPITAL GAIN	CURRENT RETURN	EXPECTED RATE OF NOMINAL RETURN	EXPECTED RATE OF REAL RETURN	NOMINAL CAPITAL GAIN	REAL CAPITAL GAIN	ANNUAL RETURN TO OWNER: IMPUTED RENT	IMPUTED RATE OF NOMINAL RETURN	IMPUTED RATE OF REAL RETURN
1970		-0.049	0.039[d]		-0.011		-0.023	0.022[d]		-0.001
1971		-0.074	0.037		-0.037		-0.047	0.024		-0.023
1972		0.071	0.061		0.122		0.117	0.026		0.143
1973		0.088	0.060		0.166		0.144	0.035		0.179
1974		0.094	0.069		0.163		0.198	0.027		0.226
1975		0.052	0.063		0.110		0.172	0.025		0.197
1976		0.075	0.042		0.110		0.120	0.022		0.142
1977		0.048	0.022		0.072		0.077	0.019		0.095
1978		0.070	0.037		0.106		0.101	0.020		0.121
1979		0.211	0.030		0.260		0.290	0.020		0.211
1980		0.092	0.029		0.121		0.163	0.018		0.170
1981		-0.037	0.028		-0.009		-0.016	0.016		-0.001
1982		-0.076	0.020		-0.056		-0.076	0.014		-0.061
1983		-0.083	0.013		-0.071		-0.101	0.015		-0.088
1984		-0.084	0.013		-0.071		-0.104	0.016		-0.087
1985		-0.083	0.017		-0.066		-0.099	0.016		-0.083
1986		-0.084	0.038		-0.047		-0.117	0.016		-0.101

TABLE A1.2 (con.)

A) CURRENTS	GROWTH RATES:[34]				SOLVENCY RATIOS:[35]			EFFICIENCY RATIOS:[36]	
YEAR	GROWTH IN REAL ESTATE (NOMINAL) (endA/begA)-1[a]	GROWTH IN EQUITY (NOMINAL) (endE/begE)-1[b]	GROWTH IN FARM ASSETS (NOMINAL)[c]		1. CAPITAL RATIO[a] A/L	2. EQUITY RATIO[b] E/A	3. LEVERAGE RATIO[c] L/E	1. TURNOVER[a] A/GI	2. SCALE[b] GI/A
1970	-0.009	0.030	-0.042		7.55	0.868	0.153	7.95	0.126
1971	-0.061	0.006	-0.038		6.71	0.851	0.175	7.58	0.132
1972	0.174	0.149	0.141		6.88	0.855	0.170	7.17	0.139
1973	0.259	0.248	0.210		6.93	0.856	0.169	6.09	0.164
1974	0.348	0.241	0.254		7.17	0.861	0.162	6.28	0.159
1975	0.204	0.234	0.171		7.63	0.869	0.151	6.27	0.160
1976	0.186	0.157	0.154		7.67	0.870	0.150	7.72	0.129
1977	0.178	0.130	0.166		7.85	0.873	0.146	9.17	0.109
1978	0.193	0.169	0.178		7.87	0.873	0.146	8.48	0.118
1979	0.417	0.455	0.377		9.50	0.895	0.118	9.90	0.101
1980	0.262	0.237	0.236		10.38	0.904	0.107	10.68	0.094
1981	0.104	0.078	0.066		9.54	0.895	0.117	9.69	0.103
1982	0.016	0.038	0.010		8.91	0.888	0.126	10.74	0.093
1983	-0.066	-0.040	-0.049		8.00	0.875	0.143	11.17	0.090
1984	-0.075	-0.069	-0.066		7.36	0.864	0.157	10.22	0.098
1985	-0.090	-0.038	-0.054		6.92	0.855	0.169	9.57	0.105
1986	-0.080	-0.032	-0.058		6.62	0.849	0.178	8.19	0.122
B) CONSTANTS									
	(endA/begA)-1	(endE/begE)-1	amf	Melichar	7.17	0.861	0.162	7.48	0.134
1970	-0.023	0.016	-0.057	-0.057	7.55	0.868	0.153	7.95	0.126
1971	-0.047	-0.042	-0.065	-0.057	6.71	0.851	0.175	7.58	0.132
1972	0.117	0.094	0.064	0.062	6.88	0.855	0.170	7.17	0.139
1973	0.144	0.142	0.103	0.095	6.93	0.856	0.169	6.09	0.164
1974	0.199	0.106	0.110	0.102	7.17	0.861	0.162	6.28	0.159
1975	0.172	0.127	0.081	0.063	7.63	0.869	0.151	6.27	0.160
1976	0.126	0.093	0.080	0.086	7.67	0.870	0.150	7.72	0.129
1977	0.077	0.033	0.057	0.058	7.85	0.873	0.146	9.17	0.109
1978	0.101	0.078	0.080	0.081	7.87	0.873	0.146	8.48	0.118
1979	0.290	0.326	0.242	0.236	9.50	0.895	0.118	9.90	0.101
1980	0.163	0.112	0.103	0.097	10.38	0.904	0.107	10.68	0.094
1981	-0.016	-0.038	-0.041	-0.045	9.54	0.895	0.117	9.69	0.103
1982	-0.076	-0.050	-0.086	-0.066	8.91	0.888	0.126	10.74	0.093
1983	-0.101	-0.061	-0.094	-0.093	8.00	0.875	0.143	11.17	0.090
1984	-0.104	-0.103	-0.098	-0.094	7.36	0.864	0.157	10.22	0.098
1985	-0.099	-0.078	-0.096	-0.096	6.92	0.855	0.169	9.57	0.105
1986	-0.117	-0.071	-0.090	-0.099	6.62	0.849	0.178	8.19	0.122

TABLE A1.2 (con.)

A) CURRENTS

	PROFITIBILITY RATIOS:[37]					EARNING RATIOS: P/E[38]		WEIGHTING RATIOS:[39]		
YEAR	1.PROFIT FOR BUSINESS (ROA)[a] (NFI+INT-RO1-ROM)/A	2.PROFIT FOR OWNER/OPERATOR (ROE)[b] NFI/E	3.PROFIT FOR OWNER (ROE)[c] (NFI-RO1-ROM)/E	4.RETURN ON BANK SAVINGS[d]	5.PROFIT FOR LENDER (ROL)[e] INT/L	1.FARM PROD ASSETS/ $EARNINGS[a]	2.VALUE OF REAL ESTATE/ $RENT[b]	1.LAND/ TOTAL ASSETS[a]	2.REAL ESTATE/ TOTAL ASSETS[b]	3.LAND/ REAL ESTATE[c]
1969	0.046	0.049	0.040	0.050	0.074	7.4	42.1	0.417	0.595	0.700
1970	0.039	0.041	0.033	0.062	0.072	7.9	44.8	0.404	0.578	0.699
1971	0.036	0.042	0.033	0.045	0.063	7.6	40.4	0.394	0.564	0.698
1972	0.047	0.052	0.043	0.040	0.067	7.2	43.1	0.406	0.578	0.700
1973	0.070	0.082	0.072	0.054	0.068	6.1	32.8	0.407	0.580	0.701
1974	0.063	0.071	0.061	0.085	0.076	6.3	44.2	0.445	0.633	0.703
1975	0.057	0.064	0.054	0.070	0.073	6.7	47.8	0.466	0.655	0.704
1976	0.038	0.040	0.032	0.076	0.079	7.7	51.1	0.482	0.682	0.706
1977	0.022	0.021	0.014	0.080	0.074	9.2	58.2	0.506	0.714	0.709
1978	0.034	0.036	0.027	0.071	0.080	8.5	54.7	0.519	0.720	0.712
1979	0.030	0.028	0.022	0.101	0.100	9.9	53.1	0.520	0.726	0.716
1980	0.026	0.023	0.018	0.112	0.106	10.7	55.6	0.547	0.762	0.718
1981	0.029	0.023	0.017	0.154	0.134	9.7	57.6	0.557	0.773	0.721
1982	0.021	0.015	0.010	0.115	0.112	10.7	54.9	0.540	0.746	0.724
1983	0.014	0.010	0.005	0.090	0.079	11.2	55.6	0.523	0.720	0.727
1984	0.014	0.009	0.003	0.077	0.087	10.2	54.8	0.518	0.710	0.730
1985	0.018	0.015	0.008	0.061	0.080	9.6	55.4	0.500	0.685	0.730
1986	0.040	0.041	0.034	0.060	0.076	8.2	54.9	0.476	0.648	0.736

B) CONSTANTS

1969	0.046	0.049	0.040	0.050	0.074	7.4	42.1	0.417	0.595	0.700
1970	0.039	0.041	0.033	0.047	0.072	7.9	44.8	0.404	0.578	0.699
1971	0.036	0.042	0.033	-0.004	0.063	7.6	40.4	0.394	0.564	0.698
1972	0.047	0.052	0.043	-0.011	0.067	7.2	43.1	0.406	0.578	0.700
1973	0.070	0.082	0.072	-0.029	0.068	6.1	32.8	0.407	0.580	0.701
1974	0.063	0.071	0.061	-0.036	0.076	6.3	44.2	0.445	0.633	0.703
1975	0.057	0.064	0.054	-0.025	0.073	6.7	47.8	0.466	0.655	0.704
1976	0.038	0.040	0.032	0.019	0.079	7.7	51.1	0.482	0.682	0.706
1977	0.022	0.021	0.014	-0.036	0.074	9.2	58.2	0.506	0.714	0.709
1978	0.034	0.036	0.027	-0.013	0.080	8.5	54.7	0.519	0.720	0.712
1979	0.030	0.028	0.022	0.003	0.100	9.9	53.1	0.520	0.726	0.716
1980	0.026	0.023	0.018	0.000	0.106	10.7	55.6	0.547	0.762	0.718
1981	0.029	0.023	0.017	0.033	0.134	9.7	57.6	0.557	0.773	0.721
1982	0.021	0.015	0.010	0.022	0.112	10.7	54.9	0.540	0.746	0.724
1983	0.014	0.010	0.005	0.024	0.079	11.2	55.6	0.523	0.720	0.727
1984	0.014	0.009	0.003	0.039	0.087	10.2	54.8	0.518	0.710	0.730
1985	0.018	0.015	0.008	0.017	0.080	9.6	55.4	0.500	0.685	0.730
1986	0.040	0.041	0.034	0.018	0.076	8.2	54.9	0.476	0.648	0.736

TABLE A1.2 (con.)

CROPS[14,15]

A) CURRENTS

YEAR	WHEAT	OATS	BARLEY	POTATOES	RYE	FLAX	RAPE	TOTAL CROP INVENTORY
1968	221508	43781	124263	3817	2494	9336	11318	416617
1969	220131	46308	114692	6680	3009	10018	14446	408276
1970	161176	48447	133520	7472	4083	17443	31582	403722
1971	126944	41123	104400	3831	4761	9626	45367	333842
1972	128096	50196	157958	5424	6641	7177	36467	391649
1973	204248	65919	200578	9566	11604	13361	96027	591293
1974	264417	97934	288745	12648	12624	11569	80091	747928
1975	272701	92966	292043	9576	11474	13659	76500	768920
1976	341186	63872	277634	8499	8318	7873	76244	803406
1977	264082	75902	311647	9666	9246	8139	97538	774419
1978	321983	69106	289234	9402	16048	9262	221606	935943
1979	501713	67909	311201	11190	27236	21356	270980	1231584
1980	616441	113824	606631	14016	22654	16466	230282	1617313
1981	699035	96274	591869	14944	25457	13029	140959	1580650
1982	659533	86530	654413	17240	18356	14545	145116	1491831
1983	665909	86816	396400	17747	17844	6627	175250	1387692
1984	403306	82113	371610	16296	12714	7126	206099	1096165
1985	377368	76472	376780	20727	11016	6131	269316	1077801
1986	619922	86123	361568	26020	12631	6169	217782	1218205

B) CONSTANTS

YEAR	WHEAT	OATS	BARLEY	POTATOES	RYE	FLAX	RAPE	TOTAL CROP INVENTORY
1969	543633	99526	283190	14026	7430	24716	35669	1008089
1970	392163	117676	324066	16180	9934	42440	76842	982282
1971	282213	96413	242227	8426	11023	20014	105266	774676
1972	282773	110812	348026	11974	14439	15843	80479	864347
1973	412622	173674	406208	18326	23442	26972	133366	1194531
1974	476570	176140	619326	22568	22706	20896	108077	1345194
1975	447766	152657	479646	16722	18841	22429	125616	1262694
1976	528[illegible]0	130034	430440	14727	12696	11896	116667	1245691
1977	374064	107610	441710	13690	13096	8696	128156	1096911
1978	420893	90337	378084	12490	19671	12107	289661	1223062
1979	597277	104654	370477	13321	32424	26423	322596	1466171
1980	658930	121667	641361	15006	24266	16669	246555	1624532
1981	667656	90997	565290	14273	24314	12444	134631	1509606
1982	573979	77306	484627	15070	13423	12714	126849	1304048
1983	573503	74260	330692	14839	14920	6641	146530	1160194
1984	324903	66167	299444	12326	10246	5744	166075	884903
1985	281396	56200	292494	16005	8508	3962	161633	832279
1986	365413	63101	260600	18647	9363	4673	161440	903043

APPENDIX 1.3

WORKING VARIABLES: DEFINITIONS AND ASSUMPTIONS

APPENDIX 1.3

WORKING VARIABLES: DEFINITIONS AND ASSUMPTIONS

1. Years of study. The time span 1970 through 1986 was chosen was because 1969 was the first year that series F (other assets) and series K (new investment) were reported. In addition, to minimize the influence of technical change on growth, a recent time span was chosen.

2. Land. Land only values reported in Statistics Canada data represent 61.2% of the land and buildings total in 1970. This figure rises to 68.9% by 1984. These values are imputed by Statistics Canada because the original data series is collected as an aggregate value of land and buildings. Since values for Newfoundland were not included in the Canadian figures prior to 1976, they have been subtracted from the 1976-1986 series in order to maintain consistency throughout the series. The land to buildings ratio is developed by Statistics Canada using a value per acre survey to determine the land values and census intercensal extrapolation for total land and building values.

3. Land and Buildings. Value data for this variable are found in both Statistics Canada Cat. No. 21-603E which superseded 21-202 in 1986, and the "Farm Net Income Reference Handbook" in the "Value of Farm Capital" tables. Since values from Newfoundland were not included in the Canadian series prior to 1976, they were subtracted from the 1976-1986 series in order to maintain consistency within the series. Canadian farm real estate is defined as land and buildings located on at least one acre and generating at least

$250 agricultural gross sales. The values are a December estimate of present market value based on a per acre index established for each census year.

It was decided to analyze farm real estate values in the study rather than to simply examine farm land values. This was because of specification problems for two variables which would render land a poor choice for study. Rent is expressed in the Statistics Canada data as a return to buildings and land, rather than land. In addition, the value of land is an estimate made on the basis of land and buildings. Therefore, the difficulty of distinguishing between land and buildings (farm real estate) and land alone were considered to make farm real estate a more reliable variable in the study.

4. Machinery and Vehicles. Data are found in Statistics Canada Cat. No. 21-603E and "Farm Net Income Handbook". This category includes implements, machinery, motor trucks and automobiles. This is a June 3 estimate of value. Newfoundland values are subtracted from the series for 1976-1986 in order to maintain consistency. The machinery and equipment inventories are estimates based on census data; their value is based on the current year's market value. The market value reflects what a machine of comparable age and condition would bring at an auction sale. It is, therefore, a replacement value and not an original or assessed value.

5. Livestock. December inventory values are found in Statistics Canada Cat. No.21-603E; "Value of Farm Capital" and also in the "Farm Net Income Reference Handbook". Livestock includes livestock, poultry and fur-bearing animals. Data for Newfoundland have been subtracted for the period from 1976

to 1986 in order to make the series consistent. The estimate of inventories is based on census data and intracensal surveys, while the value is calculated by Statistics Canada from the current year's average value for livestock.

6. Other Assets. These were found in the Farm Credit Corporation (FCC) Statistics series "Average Assets, Liabilities and Net Worth After Loan per Farm Unit". Other assets are comprised of farmers' current and monetary assets. This includes stocks, bonds, crop stocks, marketing board quota, supply inventories and a small percentage of intermediate and long term non-farm assets. Although FCC began lending in 1959, the published data are available for only 1970 to 1986. The data are published in the form of per farm averages. To derive an aggregate estimate for Canada, the FCC average for other assets was multiplied by the number of farms in Canada (excluding farms in Newfoundland). The number of farms is published every five years with census year. In intervening years, a linear extrapolation was used to estimate farm numbers. The number of farms in Alberta is also estimated using a linear extrapolation between census years.

7.Total Assets. The sum of land and building values, machinery values, livestock and values for other current and monetary assets for each year in current dollars.

8. Liabilities. These are comprised of Farm Debt found in Statistics Canada Cat. No. 21-603E, 21-202 and 21-202P in a table entitled "Farm Debt Outstanding as of December 31, Classified by Lender and by Province". This series is compiled by Statistics Canada from publications of the Bank of Canada, the Farm Credit Corporation, Provincial government lending agencies,

the annual reports of financial institutions operating in Canada and from Statistics Canada farm surveys. Liabilities are based on fourth quarter or fiscal year end figures (March 31 for governments) which are assumed to be representative of December 31 of the previous calendar year. The 1986 value will not be published until mid December, 1987. The value for 1986 was provisionally estimated for Canada as being $22,700,000 and for Alberta as $5,350,000 based on phone information with the Farm Income Branch of Statistics Canada in Ottawa which suggested that 1986 figures were not considerably different than 1985 figures. The provisional estimates may be found to over estimate total liabilities.

9. Owner's Equity or Net Worth. Calculated strictly on the basis of the accounting principle A = L + E where A is assets, L is liabilities and E is owner's equity. Owner's equity on an aggregate level is thus found by subtracting farm debt from total farm assets.

10. Annual Change in Net Worth. Calculated as the difference between the equity, E, at time t minus $E_{(t-1)}$. This is the change in net worth between the beginning and ending balance sheet for the year.

11. New Investment. This is estimated from a series published by the Farm Credit Corporation (FCC) in FCC Statistics. The series "Improvements" in the table "FCA loans approved, by purpose of loan" includes the value of new buildings, breaking and leveling land, irrigation and drainage systems. To convert the aggregate FCC value into a per unit value, the value of "Improvements" was divided by the "Number of farm units" for each year of 1979 to 1986 data and by the "Number of borrowers" for data from 1970 to

1978 from the table "FCA loans approved, by type of farm enterprise". The average value of improvements thus derived was then multiplied by the number of farms in Canada (excluding Newfoundland) to arrive at a Canadian estimate. None of the National Accounts Statistics Canada series were used for investment because a comparable series for Alberta was not published. Thus calculation was therefore of: [($FCC improvements/number FCC units) * number farms Statistics Canada].

12. Depreciation. This series can be found in Statistics Canada Farm Net Income Handbook tables of "Farm Operating Expenses and Depreciation Charges". The Newfoundland figures for the years from 1976 to 1986 were excluded in order to maintain consistency in the data. The depreciation cost is designed to reflect the declining value of farm buildings and machinery used in a year. For farm buildings, the depreciation estimate is based on building values calculated as a residual from land to building ratios (described earlier under land values).

13. Change in Livestock and Crop Inventories. Found in a series entitled "Net Farm Income" published in Statistics Canada Cat. No. 21-603E and in the "Farm Net Income Handbook". The inventories include wheat, oats, barley, rye, flaxseed, rapeseed, soybeans, corn potatoes, tobacco, cattle, calves, hogs, sheep and lambs (adjusted to reflect end of year inventory levels). The physical change in inventories are priced by Statistics Canada at a weighted or annual average price.

14. Year End Crop Stocks. These are unpublished Statistics Canada values for year end crop stocks from 1970 to 1986. In Alberta, the crops include

wheat, oats, barley, rye, flax, canola, and potatoes. At the Canadian level, additional crops included are tobacco, corn and soybeans. This series was used as part of an adjustment to the "Change in Other Assets and Liabilities " series which was performed in order to avoid double counting crop inventories in the estimation of Net Investment. Crop stocks were included in two series, the FCC "Other Assets" series and the Statistics Canada series "Change in Livestock and Crop Inventories", both of which were used in the calculation of Net Investment. The adjustment is described below (A1.15).

---

15. Annual Change in Other Assets and Liabilities. This series primarily represents the annual change in the values of current ("other") assets and liabilities. However, because of the double counting of crop inventories outlined above (A1.14), the annual change in value of year end crop inventories was subtracted from this series. This adjustment assumes that crop inventories can be consistently identified as a discreet series. In practice this is not the case due to the large and rapidly fluctuating nature of crop inventories during the year.

16. Net Investment. Conceptually, the net investment adjustment to net worth attempts to isolate pure price changes (capital gains) from other causes of variation in farm asset values. This adjustment must be made since, in addition to price changes, the value of farm assets may also respond to changes in inflation, annual capital improvements, depreciation, changes in capital or current inventories, and/or changes in total debt. The process of isolating pure price induced variations in farm asset values involves subtracting (or adding) the value of annual changes in each

variable listed above back out of changes calculated in annual net worth. Net investment is composed of the current year's new investment plus depreciation minus inventory changes minus changes in the outstanding current asset and liability position. This process effectively cancels each extraneous variable's contribution to variations in farm asset values, leaving capital gains the only variable influencing values. (Only Table A2.1 and Figure 4.1 are deflated by the "average" CPI).

17. Nominal Capital Gains. The calculation of nominal capital gains is described above (A1.16). In essence, they are annual changes in net worth minus annual changes in net investment expressed in current dollar terms.

18. Inflation Index. Indexing was based on the CPI, found in Statistics Canada Cat. No. 62-001. The percentage annual change is calculated from $(I_{(t+1)} - I_{(t)})/I_{(t)}$ where I is the index in the t'th year. In the calculation of real values, unless it is explicitly stated otherwise, all values were deflated by the December CPI so that all numbers are as consistent as possible with a December balance sheet date.

19. Year Values and the CPI. All values are deflated by the December Consumer Price Index (CPI) in order to be consistent with a December balance sheet date. One specification difference between the Canadian and U.S. balance sheet models is the use of a December 31 balance sheet in Canada rather than a January 1 balance sheet. A December 31 balance sheet date better coincided with Canadian farm data: a December estimate for the value of Canadian farm real estate, inventory of livestock and estimates of liabilities.

20. Annual Change in the Purchasing Power of Net Worth. Calculated by multiplying the percentage change in the CPI by the value of the Net Worth.

21. Real Capital Gain of Farm Assets. Calculated by adjusting nominal capital gains into real dollar terms. In the CMF method this is done by subtracting the real dollar value of net investment from the real dollar value of net worth. The Melichar method calculates nominal capital gains, (the nominal values of net worth minus net investment), and adds it to the annual change in the purchasing power or net worth (A1.20)

22. Nominal Capital Gains on Farm Real Estate. Calculated by subtracting the nominal value of farm real estate at the beginning of the year from its value at the end of the year.

23. Real Capital Gains on Farm Real Estate. Calculated by subtracting the constant dollar value of farm real estate at the beginning of the year from its value at the end of the year.

24. Net Farm Income. Found in the Statistics Canada series "Agricultural Economic Statistics" Cat. No. 21-603E , Net Farm Income tables for 1970-1986. This was adjusted to exclude Newfoundland data for the period from 1976 to 1986. These series are comprised of December estimates of cash receipts plus income in kind plus supplementary payments plus the value of inventory payments minus operating and depreciation charges. There are two important limitations to these series. First, net farm income is associated with the sale of agricultural products. It is not indicative of cash flow to

the sector or to the farmer since income from the sale of farm capital is considered investment income and has therefore not been included in net farm income. Other incomes such as nonfarm wages and salaries, rental or pension incomes are also not included in net farm income. Secondly, the Canadian net farm income series was initially derived as part of an interprovincial business statement. This means that intraprovincial sales and purchase transactions are not included by Statistics Canada since they essentially canceled each other out within the provincial ledger. However, by not including these intrafarm transactions, the volume of sales and purchases is not fully represented.

25. Interest on Debt. Found in the Statistics Canada series "Farm Operating Expenses and Depreciation Charges" from Cat. No. 21-603E. This is an estimation, compiled by Statistics Canada, from chartered banks, federal and provincial lending agencies, the FCC, credit unions, insurance, loan and trust companies. The Canadian values have been adjusted to exclude Newfoundland values.

26. Gross Farm Income. Found in the Statistics Canada series "Agriculture Economic Statistics" Cat. No 21-603E. Gross income is composed of cash receipts plus income in kind plus supplementary payments plus the value of inventory changes. The Canadian values have been adjusted to exclude Newfoundland.

27. Imputed Return to Management. Calculated by multiplying gross income by 5% (0.05). This multiplier for estimating renumeration for management followed a precedent for its use set by Brinkman and Clark (1985).

28. Imputed Return to Operator's Labor. Based on a monthly "Hired Labor Wage" Statistics Canada series where 1940-1976 data is found in Cat. No. 21-003b and 1977-1986 data is found in Cat. No. 21-002. The wage used is the January (pre-1976) or February (post 1977), no board, monthly wage which is then multiplied by 12 to reflect the wage earned from a full year of hired service. This is a very conservative estimation of hired farm labor renumeration; it means that the 1986 Canadian daily wage for operator's labor is $46.04.

29. Actual Return to Owner's Equity (ROE). Calculated by subtracting imputed returns to management (ROM) and imputed returns to operator's labor (ROl) from net farm income.

30. Actual Return to Production Assets (ROA). Calculated by adding interest on debt to net farm income and subtracting the value of imputed returns to management and imputed returns to operator's labor.

31. Imputed Farm Rent. Calculated by extrapolating an average gross farm rent per acre leased to a rental value for every acre farmed. Imputed farm rent represents the annual return which accrues to the owner of farm land for the use of the productive services of the land. Imputed rent estimates the returns to the landlord for use of his land whether or not it is paid by a tenant or, in essence, by the owner/operator himself.

The calculation of imputed rent is based on the series gross farm rent which is listed in "Agricultural Economic Statistics", Cat. No. 21-603E, in the table entitled "Farm Operating Expenses and Depreciation Charges". Although the gross rent is reported as an expense, rent can be expressed as an item of income for the owner. Gross rent includes income from rental of land and buildings whether it was paid on a cash or a share basis. The calculation of imputed rent begins by converting gross farm rent into an average gross farm rent by dividing annual gross farm rent by the number of acres rented. Imputed farm rent is the product of this average gross farm rent and the total area farmed (in Canada or Alberta).

Both series, number of acres rented and number of acres farmed are found for census years in "Census Canada 1986: Agriculture", Cat. No. 96-102, in table 31 entitled "Other Selected Farm Data 1971, 1976, 1981, 1986.". Annual data for these two series was calculated using a linear extrapolation between census years. It was suggested in a phone conversation with Statistics Canada in Ottawa that the series reported in the Alberta, 1981 census for number of acres rented and total acres farmed were each underestimated by 2,000,000 acres. Since this error has not been corrected in a Statistics Canada published series, it was not considered. If there is a bias in the data, it would affect both annual and economic estimates of returns to farm real estate and the price/ earnings ratios for Alberta from 1977 to 1985.

32. Return to Farm Assets. The returns shown are the nominal dollar and real dollar rates of capital gain in aggregate values of farm assets, annual returns from owning farm assets (gross farm income) and expected rates of return when both aggregate capital gains and annual incomes are considered as an annualized income stream.

a) Rate of nominal capital gain on farm assets is calculated by dividing nominal capital gains on farm assets (the difference between net worth and net investment) by the beginning of the year value of total farm assets.

b) Rate of real capital gain on farm assets is calculated by dividing real capital gains on farm assets (the real dollar difference between net worth and net investment) by the beginning of the year value of total farm assets.

c) Rate of nominal annual return to farm assets for the owner is calculated by adding interest on debt to gross farm income and then subtracting returns for labor and management. The resulting term is then divided by the beginning of the year value of total farm assets.

d) Rate of real annual return to farm assets is calculated by adjusting nominal annual returns to farm assets by the CPI.

e) Rate of expected nominal return to farm assets is the sum of the rate of nominal capital gain in farm asset values and the rate of nominal annual return.

f) Rate of expected real return to farm assets is the sum of the rate of real capital gain in farm asset values and the rate of real annual return.

---

33. Return to Farm Real Estate. The returns shown are the nominal dollar and real dollar rates of capital gain in aggregate values of farm real estate, annual returns from owning farm real estate (imputed rental income) and

imputed economic rates of return when both aggregate capital gains and annual incomes are considered as an annualized income stream.

a) Rate of nominal capital gain on farm real estate is calculated by dividing nominal capital gains from farm real estate (the nominal dollar value at the end of the year minus the value at the beginning of the year) by the beginning of the year nominal value of farm real estate.

b) Rate of real capital gain on farm real estate is calculated by dividing the real capital gains from farm real estate (the real dollar value at the end of the year minus the value at the beginning of the year) by the beginning of the real dollar value of farm real estate.

c) Rate of nominal annual return to farm real estate is the nominal value rental income divided by the value of farm real estate. Both variables are found in Statistics Canada Cat. No. 21-603E.

d) Rate of real annual return to farm real estate is the value of rental income divided by the value of farm real estate expressed in real dollar terms.

e) Rate of imputed nominal return to farm real estate is the sum of the rate of nominal capital gain in farm real estate values and the rate of nominal annual return to farm real estate ownership.

f) Rate of imputed real return to farm real estate is the sum of the rate of real of capital gain in farm real estate values and the rate of real annual return.

34. Growth Rates. The three measures used to estimate growth in the farm sector were: growth in farm real estate values, growth in the value of equity in farm assets and growth in the value of farm assets. The growth rates are all calculated from aggregate, nominal and real dollar values of Canadian and Alberta data.

a) Growth in real estate values is the annual change in real estate value calculated by: [(end of year value/beginning of year value) - 1].

b) Growth in equity values is calculated by subtracting annual aggregate values of total farm liabilities from annual aggregate values of total farm assets. Growth in equity is the annual change calculated by : [(end of year value/ beginning of year value) - 1].

c) Growth in farm asset values, a measure of capital gain in farm asset values, is calculated by subtracting net investment from annual changes in owner's equity (i.e. net worth) of farm assets.

d) CMF and Melichar methods of calculating real capital gain in farm asset values differ in a minor technicality of discounting dollar values by the CPI. These two methods are discussed in Chapter 3.

35. Solvency. The ability of a business to meet its long-term financial obligations is measured using the following financial ratios:

a) Capital ratio = assets/ debt. This measures the amount of assets available to cover total debts.

b) Leverage ratio = debt/ equity. This measures the propor[illegible] ownership controlled by the owner and lender.

c) Equity ratio = equity/ assets. The equity ratio measures the proportion of assets owned by the owner.

36. Capital efficiency. The efficiency with which capital generates annual income is measured in the following financial ratios:

a) Turnover = assets/ Gross Farm Income (GFI). This is the number of years needed to turnover the price of assets one time with income produced on the farm.

b) Scale = GFI/ assets. The amount of money earned per dollar of assets.

37. Profitability. Measures the profitability of annual income relative to investment. The following ratios measure different aspects of profitability.

a) Return on assets (ROA) = Net Farm Income (NFI)/ assets. ROA measures the net earnings of both owner and lender in relation to the total capital invested in the business.

b) Return on equity (ROE) = NFI + interest / assets. This is an earnings measurement of the return to owner/ operator.

c) An alternate form of ROE is expressed as ROA = NFI + interest - Ro_l - Ro_m / assets. The latter form measures the return to owner.

d) Bank rate: The interest on savings is the typical interest rate on non-chequing savings deposits posted in the 5 largest Canadian chartered banks. The data series are found in FCC **Statistics**, table of "Canadian bond yields and other interest rates". FCC compiles the contents of this series from the **Bank of Canada Review**. This interest rate is complied from the "typical" rates listed by the five largest Canadian chartered banks for non-chequing savings deposits. It was used in this study as an example of a reasonable return which could have been expected from investment of equity capital in the money market. The real interest rate on savings is calculated by subtracting the rate of change in the CPI from the Chartered Bank rate.

e) Return to lender (ROL) = Interest paid on debt/ liabilities. This measures the profits made by the lenders on business loans.

38. Price to earnings (P/E) ratios for aggregate Canadian and Alberta values from 1970 to 1986. Dollar terms, nominal or real, have no differentiating impact on price earnings ratios.

a) The P/E for farm assets is calculated by dividing the value of farm assets by the value of gross farm income.

b) The P/E for farm real estate is calculated by dividing the value of farm real estate by the value of imputed rental income.

39. Weighting Ratios. The ratios reflect the percentage of total farm assets that which is composed of either farm land or farm real estate. This percentage is not influenced differentially by real or nominal dollars. The ratios are: a) calculated by dividing the value of land by the value of total farm assets; b) calculated by dividing the value of farm real estate in land and buildings by the value of total assets; and c) calculated by dividing the value of farmland by the value of farm real estate.

APPENDIX 2

CANADIAN FARM REAL ESTATE VALUES, 1926-1986

TABLE A2.1 CANADIAN FARM REAL ESTATE VALUES 1926-1986
(Thousands of Constant and Current $)

YEAR	CURRENT LAND & BLDG. VALUE	C.P.I. FAMILY LIVING INDEX (Averaged) (1981=100)	CONSTANT LAND & BLDG. VALUES
1926	4698745	18.6	25262070
1927	4698745	18.3	25676202
1928	4698745	18.3	25676202
1929	4698745	18.6	25262070
1930	4440476	18.4	24133022
1931	4053282	16.6	24417361
1932	3489400	15.1	23108609
1933	3425200	14.4	23786111
1934	3467808	14.6	23752110
1935	3449255	14.7	23464320
1936	3292258	15.0	21948387
1937	3253346	15.4	21125623
1938	3083056	15.6	19763179
1939	3106885	15.5	20044419
1940	2963226	16.1	18405130
1941	3029846	17.0	17822624
1942	3238024	17.9	18089520
1943	3454480	18.2	19005990
1944	3649477	18.3	19942497
1945	3711473	18.4	20171049
1946	3897005	19.0	20510553
1947	4214119	20.8	20260188
1948	4665126	23.7	19684076
1949	4716823	24.5	19252339
1950	5022642	25.2	19931119
1951	5512519	27.9	19758133
1952	5668467	28.5	19889358
1953	6295977	28.3	22247269
1954	6183050	28.5	21694912
1955	6567066	28.5	23042337
1956	6852657	28.9	23711616
1957	6958491	29.8	23350641
1958	7446775	30.6	24335866
1959	7842190	31.0	25297387
1960	7409115	31.4	23595908
1961	7693535	31.6	24346630
1962	8956669	32.0	27989584
1963	9571797	32.6	29361340
1964	10536963	33.2	31737840
1965	11816736	34.0	34755106
1966	13149821	35.2	37357446
1967	14828164	36.5	40625107
1968	16338228	38.0	42995337
1969	16626354	39.7	41879985
1970	16738363	41.0	40825276
1971	16911982	42.2	40075787
1972	18349579	44.2	41514885
1973	22232843	47.6	46707653
1974	29020886	52.8	54963799
1975	36816100	58.5	62933504
1976	43555366	62.9	69245415
1977	49880119	67.6	73823150
1978	59287604	73.9	80226798
1979	73150956	80.7	90645546
1980	92028372	88.9	103518979
1981	103275080	100.0	103275080
1982	103640262	110.8	93538143
1983	99403679	117.2	84815426
1984	95041903	122.3	77712104
1985	88387042	127.2	69486668
1986	82035526	132.4	61960367

a) Source: Statistics Canada, 21-603E.
b) Source: Statistics Canada, 62-001.
c) Calculated by [(current value for land and buildings)/CPI] x 100.

APPENDIX 3

CANADIAN INDEX VALUES FOR FARM ASSETS AND INCOMES, 1970-1986

TABLE A3.1 Indexed Values of Canadian Farm Sector Variables. All variables reported as fraction of 1981 value.

CANADA: 1981 INDEX = 1.00

	LAND	R.ESTATE	MACHINERY	LIVESTOCK	OTHER ASSETS	TOTAL ASSETS	LIABILITIES	NET FARM INCOME	GROSS FARM INCOME	IMPUTED RENT	YEAR END CROP STOCK
1969	0.370	0.416	0.582	0.790	0.762	0.498	0.627	0.684	0.610	0.576	0.660
1970	0.374	0.413	0.573	0.827	0.834	0.504	0.606	0.712	0.572	0.586	0.773
1971	0.361	0.399	0.544	0.770	0.860	0.489	0.612	0.766	0.597	0.536	0.719
1972	0.378	0.411	0.547	0.887	0.814	0.513	0.618	0.826	0.630	0.532	0.694
1973	0.418	0.466	0.568	1.074	1.003	0.586	0.640	1.483	0.831	0.621	0.904
1974	0.482	0.529	0.618	0.982	0.837	0.693	0.679	1.442	0.869	0.700	0.906
1975	0.572	0.610	0.741	0.734	1.020	0.677	0.743	1.624	0.920	0.764	0.904
1976	0.647	0.664	0.841	0.747	0.936	0.724	0.812	1.144	0.863	0.767	0.898
1977	0.686	0.717	0.857	0.684	0.839	0.746	0.844	0.884	0.795	0.770	0.640
1978	0.756	0.766	0.898	0.866	0.893	0.786	0.907	0.986	0.862	0.856	0.936
1979	0.863	0.862	0.956	1.136	1.074	0.920	0.874	0.970	0.921	0.942	1.020
1980	0.981	0.988	0.989	1.104	1.001	1.002	0.902	0.767	0.902	1.068	0.911
1981	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.955
1982	0.927	0.918	0.966	0.904	1.084	0.940	1.008	0.897	0.862	0.942	0.854
1983	0.865	0.842	0.948	0.818	1.196	0.890	1.027	0.617	0.813	0.916	0.801
1984	0.791	0.776	0.912	0.796	1.211	0.840	1.006	0.624	0.837	0.882	0.696
1985	0.704	0.692	0.857	0.782	1.363	0.786	0.987	0.766	0.844	0.766	0.804
1986	0.634	0.618	0.837	0.790	1.333	0.724	0.972	0.862	0.848	0.684	0.748

APPENDIX 4

POLYNOMIAL REGRESSIONS DETAILED

4.1 Polynomial Regressions

4.2 Calculation of Functional Form

4.3 Historical Farm Real Estate Values Described by a Cubic Model

4.1 POLYNOMIAL REGRESSIONS

1. LINEAR POLYNOMIAL REGRESSION.

a. Mathematical form: $y = 2777283\ x^2 + 42916148$

where: y = farm real estate values.
x = time, in years, for the period from 1970 to 1986.

b. Lotus 123 Statistical Analysis:

```
Constant                42916148
Std Err of Y Est            14358563
R Squared                       0.53
No. of Observations           18
Degrees of Freedom             16

X Coefficient         2777283
Std Err of Coef.       652325
```

2. QUADRATIC POLYNOMIAL REGRESSION.

a. Mathematical form: $y = -402027\ x^2 + 9611743\ x + 24690920$

where: y = value of farm real estate.
x = time, in years, for the period from 1970 to 1986.

b. Lotus 123 Statistical Analysis:

```
Constant                24690920
Std Err of Y Est         10418347
R Squared                       0.77
No. of Observations           18
Degrees of Freedom             15

X Coefficient         9611743
Std Err of Coef.      1805248

X2 Coefficient      -402027
Std Err of Coef.       102476
```

3. CUBIC POLYNOMIAL REGRESSION.

a. Mathematical form: $y = -81790\ x^3 + 1683626\ x^2 - 4169927\ x + 41376146$

where: y = value of farm real estate.
x = time, in years, for the period from 1970 to 1986.

b. Lotus 123 Statistical Analysis:

Constant	41376146
Std Err of Y Est	4035179
R Squared	0.97
No. of Observations	18
Degrees of Freedom	14
X Coefficient	-4169927
Std Err of Coef.	1642448
X^2 Coefficient	1683626
Std Err of Coef.	228388
X^3 Coefficient	-81790
Std Err of Coef.	8820

4.2 CALCULATION OF FUNCTIONAL FORMS

Table A4.1 A working table showing the calculation of linear, quadratic and cubic polynomial regressions for farm aggregate Canadian real estate values versus time. All values are reported in constant dollar terms and in ('000) of dollars.

Land & bld^a	Year	Year code=x^b	x(x)^b	x(x)x^b	Cubic^c	Quadratic^d	Linear^e
40725944	1970	1	1	1	38808056	33900636	45693430
39238937	1971	2	4	8	39116475	42306298	48470713
40506797	1972	3	9	27	41810664	49907906	51247996
44914834	1973	4	16	64	46398878	56705459	54025279
52195838	1974	5	25	125	52393378	62698959	56802561
60165189	1975	6	36	216	59300420	67888404	59579844
67436420	1976	7	49	343	66630263	72273795	62357127
70725411	1977	8	64	512	73892164	75855132	65134410
77415322	1978	9	81	729	80595382	78632415	67911693
86995962	1979	10	100	1000	86249176	80605643	70688975
98440394	1980	11	121	1331	90362602	81774818	73466258
98587548	1981	12	144	1728	92445519	82139938	76243541
90518276	1982	13	169	2197	92008585	81701004	79020824
83040406	1983	14	196	2744	88555258	80456016	81798106
76516867	1984	15	225	3375	81600797	78410974	84575389
68187314	1985	16	256	4096	70652458	75559878	87352672
60750737	1986	17	289	4913	55219501	71904727	90129955

a) Land and buildings. The value of farm real estate is found in Statistics Canada 21-603E. It has been converted to real dollar values in this series.

b) Year code. The independent variable in the regression analysis is time, in years. In order to simplify the coding for the regression, years with a code of 1,2,3...etc. were used to represent the year by year annual data instead of their calander year numbers. For the higher degree polynomials, time is squared and cubed (as represented in the second and third columns of year codes).

c) Cubic. By plugging the x, x^2, and x^3 (in coded form) into the functional form derived by regression analysis (reported on the previous page), the values for the cubic function can be calculated.

d) Quadratic. Calculated in exactly the same way as the cubic values (c).

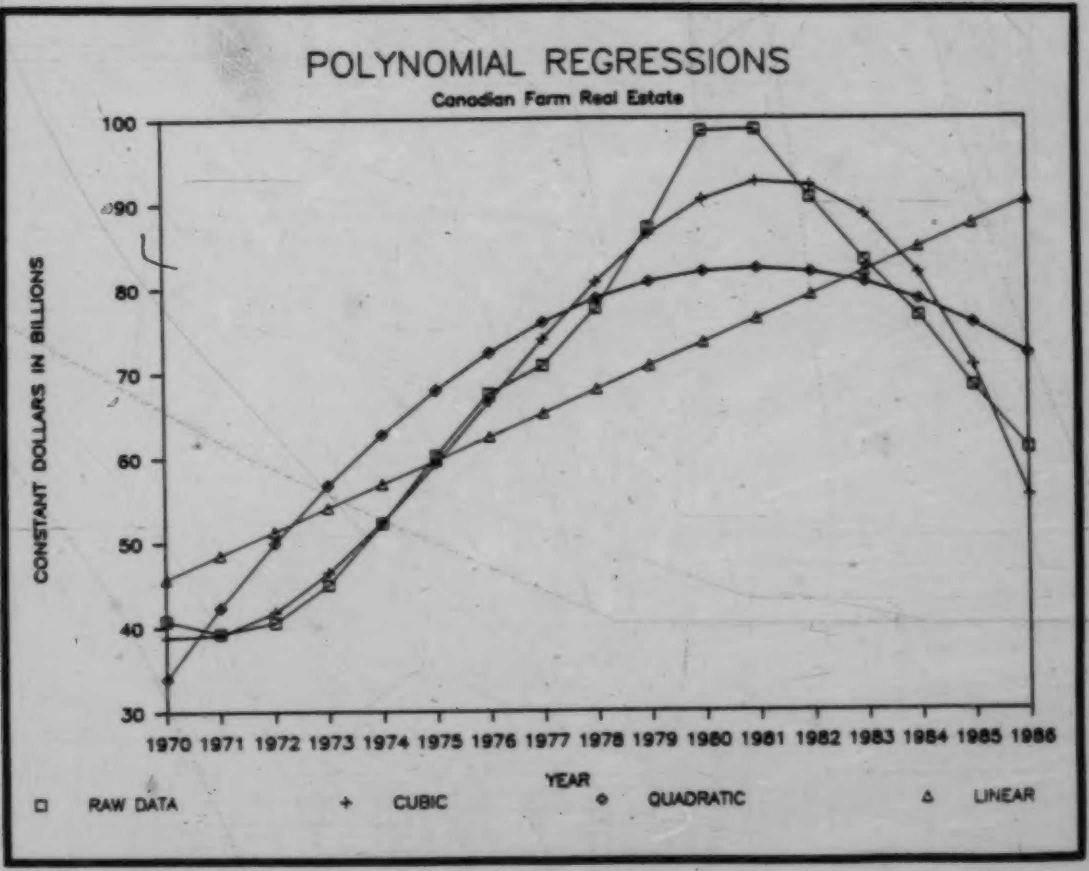
e) Linear. Calculated in exactly the same way as the cubic values (c).

4.3 HISTORICAL FARM REAL ESTATE VALUES DESCRIBED BY A CUBIC MODEL

It appears from both a statistical and visual analysis that a cubic model best describes the trend in farm real estate values between 1970 and 1986. Use of the cubic form implicitly assumes that growth in farm real estate values is quadratic in form and that the rate of growth in farm real estate values is linear and thus not constant over time. The cubic form may best describe the pattern of growth in a dynamic environment.

The time period over which growth in values of farm real estate are observed is critical to the investor's perception of value. With each additional polynomial order, the degrees of freedom in the calculation of growth decrease. When there are less than 20 observations in the regression, the conclusion is sensitive to each year's value. End values and beginning values are also likely to influence the calculated growth rates. It would therefore be unlikely that an investor would feel confident enough about the significance of the cubic form to incorporate it into his future plans. However, from the fit of each functional form shown in Figure A4.1, it is also obvious that neither a linear nor quadratic model could have so adequately describes land values in the mid and late 1980's based on the growth in farm real estate between 1969 and 1986.

The first derivative of Equation 4.1 gives the historic growth rate as estimated by the model; this can be compared to the actual growth rate. The actual growth rate shown in Figure 4.3 was calculated by taking the



Appendix Figure A4.1 Polynomial regressions of Canadian farm real estate values. Regressions performed on the real dollar farm estate values (raw data) versus time included linear, quadratic and cubic functional forms, the results of which are shown on the graph. Clearly the best fit is provided by the cubic form. Farm real estate values are expressed in constant (1981) dollar terms. The source of the real estate values is Statistics Canada Cat. No. 21-603E. These values are also listed in Table A1.1.

difference between the land value at the end of one year minus that at the end of the previous year. This calculation is conceptually identical to the first derivative of the functional form except that it gives a series of snapshots on a segment by segment basis rather than a estimate for the period.

Such comparison yields five similarities and only one appreciable difference. These include:

1)The minimum real value for farm real estate was in 1970 (the functions' slope = 0). This concluded several years of negative growth in the late 1960's.

2)The maximum real value for farm real estate was in 1981 (the functions' slope = 0). This heralded the decline in land values seen in the early 1980's.

3)Capital gains (i.e. positive growth; with the function having a slope greater than 0) were experienced during 9 years out of the period from 1972 to 1981.

4)Capital losses (i.e. negative growth; with the function having a slope less than 0) were experienced during 7 years of the study in 1970 and from 1981 to 1986.

5)Rates of growth in Canadian farm real estate values were constant and negative for 4 years during the 17 year period. This was from 1982 to 1984 and in 1986.

6)Growth was zero in 1981.

For the first nine years of the study period, the fitted growth rate Equation 4.1 is very similar to actual growth rates. However, in the last eight years (1978-1986), the growth rates described in Figure 4.3 by the actual rate and the first derivative of the cubic functional form diverge sharply. The actual growth rate series indicates that the largest rate of growth took place in 1980. It also appears that during 1980 to 1982, the greatest capital loss occurred. In contrast, the cubic functional form suggests a rate of growth that peaked in 1976 - four years ahead of the actual situation. From 1978 to 1986 the cubic functional form "smoothes out" the highest rates of capital gains and losses actually experienced by farmers and investors.

APPENDIX 5

THE CALCULATION OF STATISTICAL MEASURES OF RISK

APPENDIX 5

THE CALCULATION OF STATISTICAL MEASURES OF RISK

1. Average.

a. Single asset. $x = \text{SUM}(A_1 + A_2 ... + A_n) / n$

where: n = the number of samples.

A_n = the value of an observation.

b. Portfolio. $x_{12} = w_1 x_1 + w_2 x_2$

where: w_j = a weighting function, used as the average value of the asset in the farm portfolio. In the case of a two-asset portfolio $w_1 = 1 - w_2$

x_j = the mean of a sample population.

2. Variance.

a. Single asset. $v = \text{SUM}[(x_1 - A_1)^2 + (x_2 - A_2)^2 ... (x_n - A_n)^2] / n$

where: v = the variance of a group of observations.

Note that predicted values from a functional form may substituted into the calculation of variance in place of the mean. For risk analysis, one may wish to assume a growth model and calculate variance as:

$$v = \text{SUM}[(p_1 - A_1)^2 + (p_2 - A_2)^2 ... (p_n - A_n)^2] / n$$

where p_n = is the value predicted from the model at observation n.

b. Portfolio variance. $v_{12} = w_1^2 v_1 + w_2^2 v_2 + 2 w_1 w_2 r_{12} SD_1 SD_2$

where: r_{12} = the correlation coefficient between the two sample groups.

SD_j = the standard deviation of the sample group j; the square root of v_j.

3. Standard deviation. The square root of the variance.

4. Coefficient of variation. For both portfolios and a single asset:

$$COV = SD / \overline{x}$$

This version of the coefficient of variation expresses the variation as net of the beginning value. In order to express the variation in terms of its gross variation, the beginning value (x_1) was included in the estimation of the coefficient of variation using the form:

$$COV = SD / (x_1 + \overline{x})$$